Sears

owners manual

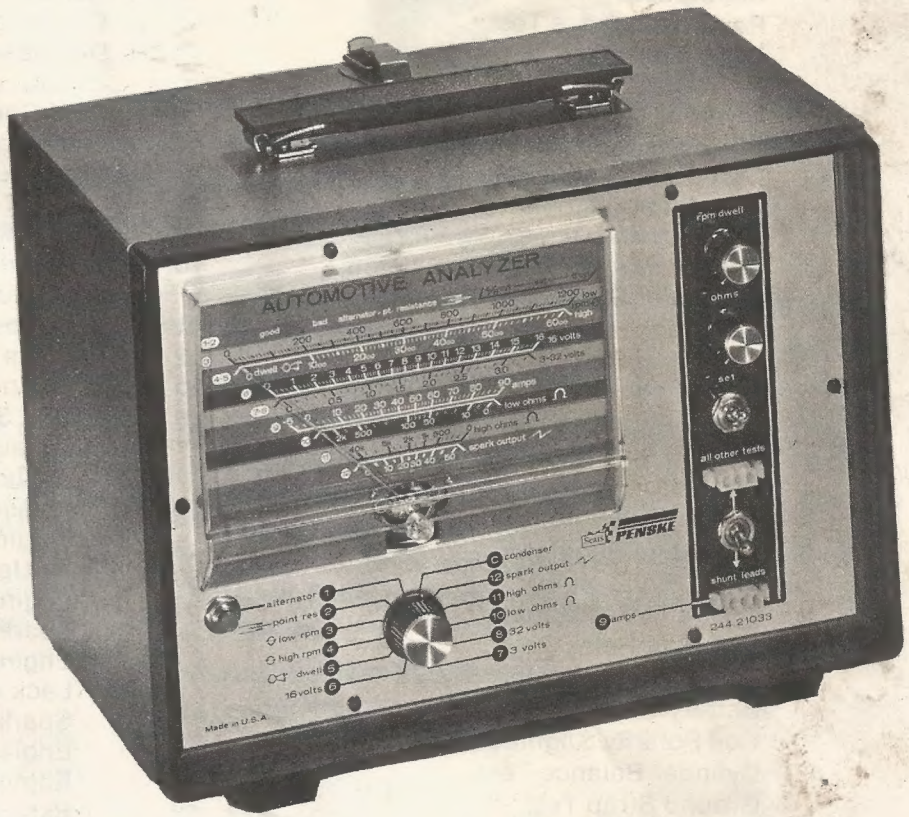
AUTOMOTIVE ANALYZER

MODEL NO.
244.21033

INTRODUCTION

OPERATION

REPAIR PARTS



SEARS, ROEBUCK AND CO. U.S.A.

3-0310-6

PRINTED IN U. S. A.

RULES FOR SAFE OPERATION

1. Always operate vehicle in a well ventilated area to avoid carbon monoxide poisoning.
2. Set parking brake and place gear shift lever in the neutral or park position.
3. Avoid contact of hands or test leads with fan blade, fan belt, power steering belt and air conditioner belt.
4. Do not touch hot exhaust manifold, radiator, high voltage spark plugs or coil terminals; while not lethal, an involuntary jerk of the hands may cause you injury.
5. Avoid high engine speeds in neutral position, as this may damage the engine.
6. The gas formed above the electrolyte while a battery is being charged is explosive. Do not smoke or permit flame or spark to occur near a battery on charge.
7. Never puncture the spark plug cables to hook up a timing light or other test equipment. Always use the proper adapter.
8. A battery is capable of providing very high currents. Therefore, reasonable care must be exercised when working near the battery to prevent shorting it out.

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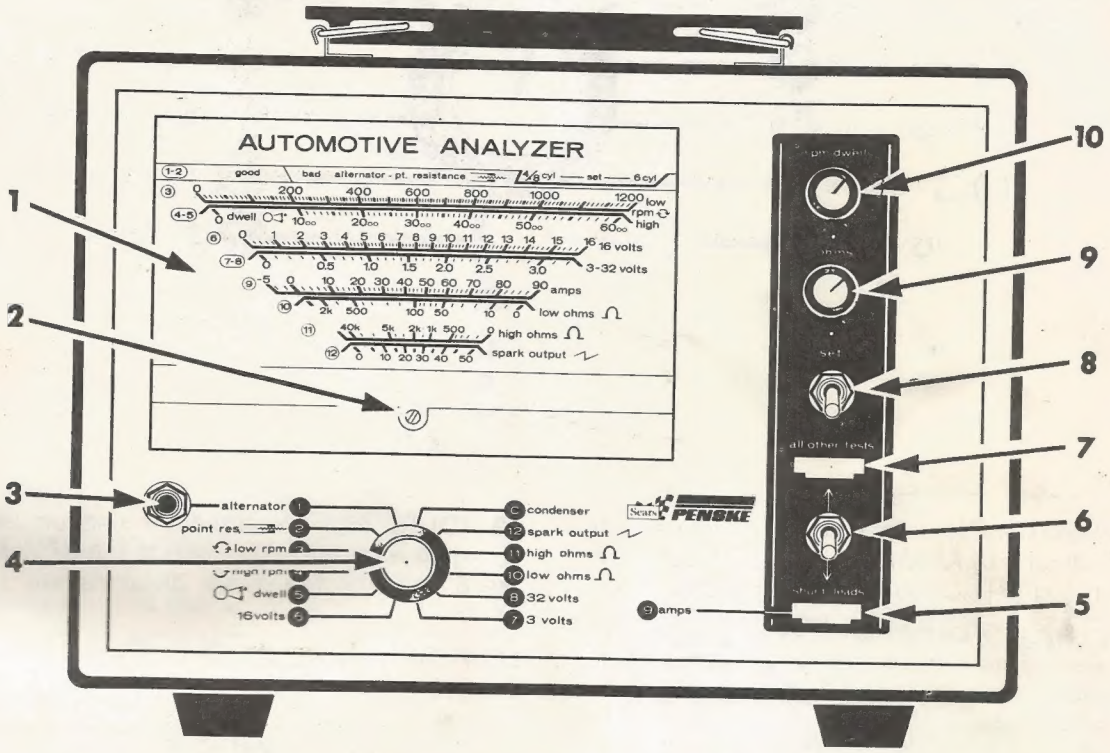
Note: Illustrations are shown as a typical 12 volt negative grounded battery circuit. On a positive grounded battery circuit, the test lead connections must be reversed. A ground connection in the illustrations means a good connection to the engine block or the vehicle frame.

INTRODUCTION

The AUTOMOTIVE ANALYZER, Model 21033, was designed to test the automotive ignition system, charging system and to take measurements of the voltages, resistances and charging current found in an automotive system.

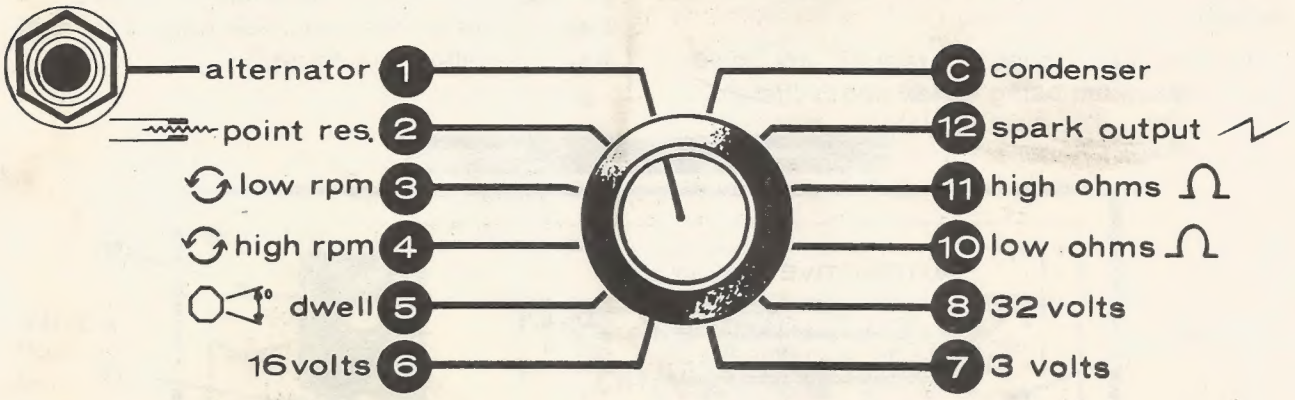
The ANALYZER does not require any power from the system being tested and is therefore completely portable. It will test most systems regardless of voltage or type.

Three "C" size flashlight cells are used to power the tester. The cells should be replaced at least once a year or when the 6 CYL Set Line cannot be reached. See page 3 for battery installation procedure.



1. **METER FRONT**—Occasionally, the meter cover should be cleaned with a clean cloth and a solution of 10 parts water to one part detergent. Never use gasoline or thinner on the meter front.
2. **ZERO ADJUSTING SCREW**—Before connecting leads to an engine, rotate the zero adjusting screw until meter pointer rests on zero.
3. **ALTERNATOR TEST BUTTON**—Completes the internal ANALYZER circuitry when testing Alternator Diodes.
4. **SELECTOR SWITCH**—The 12 Selector switch positions are keyed by numbers to correspond to the meter scales. A short description of each switch position is given on page 2.
5. **SHUNT LEAD RECEPTACLE**—Provides the necessary connections between Shunt lead and the ANALYZER.
6. **TEST SWITCH**—Internally selects the circuitry in which the ANALYZER meter is connected. The switch is placed in the ALL OTHER TESTS position except when using the Amps scale. To read the Amps scale, the switch must be in the AMPS position.
7. **ALL OTHER TESTS RECEPTACLE**—Provides the necessary connection between the test leads and the ANALYZER.
8. **SET SWITCH**—Used in calibrating the ANALYZER to the RPM, DWELL and OHMS positions of the Selector switch.
9. **OHMS CALIBRATOR**—Used to calibrate the HIGH-OHMS and LOW-OHMS positions of the Selector switch.
10. **RPM AND DWELL CALIBRATOR**—Used to calibrate the RPM and DWELL positions of the Selector switch.

SELECTOR SWITCH POSITIONS



ALTERNATOR (1) — Provides a rapid test of the conditions of Alternator diodes. Results are read on a simple Good-Bad meter scale.

POINT RESISTANCE (2) — This position is used to determine the condition of the ignition points. Results are read on a simple GOOD-BAD scale.

LOW RPM (3) — The low RPM scale (0-1200 RPM) is ideally suited to engine idle RPM adjustments as each small division represents 10 RPM.

HIGH RPM (4) — The high RPM scale (0-6000 RPM) facilitates the testing of charging and carburetor systems. Each division represents 100 RPM.

DWELL (5) — Dwell (amount of time the ignition points remain closed) is read on the 0-60 scale. Each division represents 1 degree of dwell.

16 VOLTS (6) — Special green bands on this easy to read 16 volt scale (over 4 inches long) designates the areas for setting regulators on both 6 and 12 volt charging systems. The smallest divisions are .2 volt.

3 VOLTS (7) — The 3 volt scale is ideal for making low voltage measurements such as detecting voltage losses, since the smallest divisions are .1 volt and the larger divisions are .5 volt.

32 VOLTS (8) — Provided for use on 24 volt charging systems. The major meter divisions are 5 volt and the minor divisions are 1 volt.

LOW-OHMS (10) — The Low-Ohms position is used for making continuity checks and measuring low resistances such as primary windings of ignition coils, ballast resistors, etc. The non-linear scale has a range of 0 to 2000 ohms.

HIGH-OHMS (11) — The High-Ohms position is used for measuring the resistance of ignition coil secondaries, radio suppressor ignition cables, condenser leakage, etc. The range of the non-linear scale is from 0-40,000 ohms.

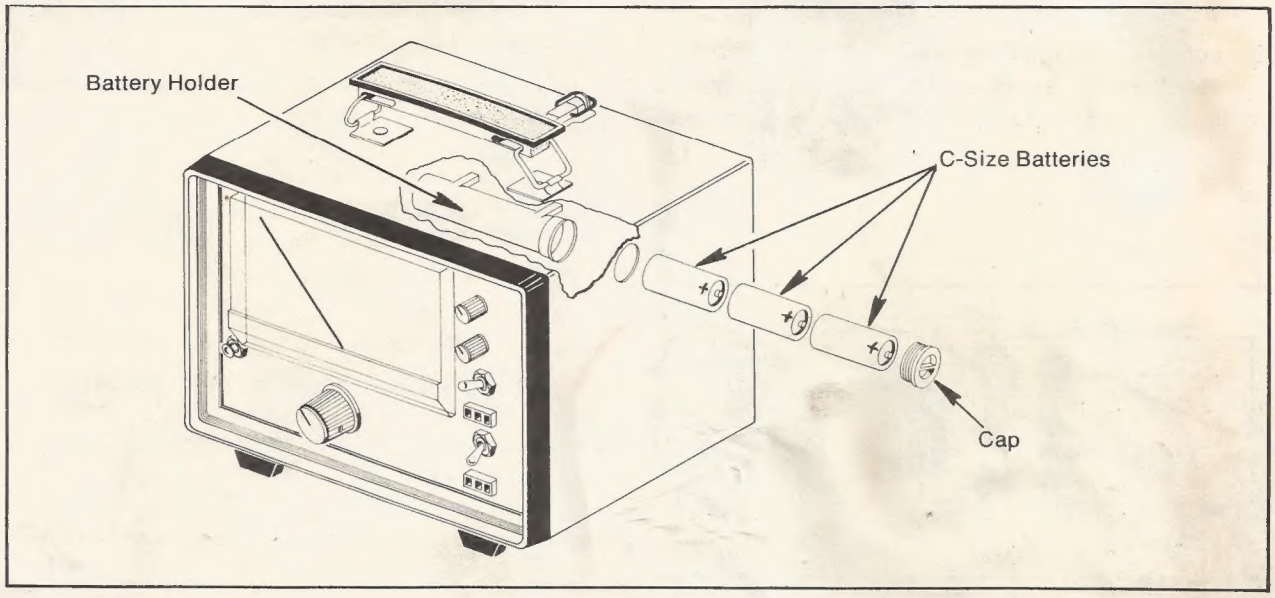
SPARK OUTPUT (12) — A relative indication of the energy developed by the ignition coil is indicated on a 0 to 50 point scale.

CONDENSER (C) — This position provides a known good condenser that can be substituted for an ignition condenser whose condition is doubtful.

Note: *The Ammeter scale (0-90 Amps) can be used in any Selector switch position provided that the Test switch is in the AMPS position and the Shunt lead is connected into the circuit to be tested.*

BATTERY INSTALLATION PROCEDURE

1. Unscrew battery holder cap shown below.
2. Insert three 1½ Volt "C" size batteries with the positive (+) end as shown.
3. Replace battery holder cap and tighten.
4. Turn Selector switch to the LOW-OHMS (10) position and press down on the SET switch. Meter pointer should move to the right (upscale), if not, retighten the battery holder cap.



CALIBRATION

1. Calibration of the AUTOMOTIVE ANALYZER can be accomplished at any time even though the leads are connected to the engine.

DWELL-RPM POSITIONS

1. Turn Selector switch to the desired position (LOW RPM, HIGH RPM or DWELL). Press the SET switch and adjust the RPM-DWELL calibrator until the meter pointer reads on the selected Set Line (4 and 8 CYL or 6 CYL depending on engine to be tested).

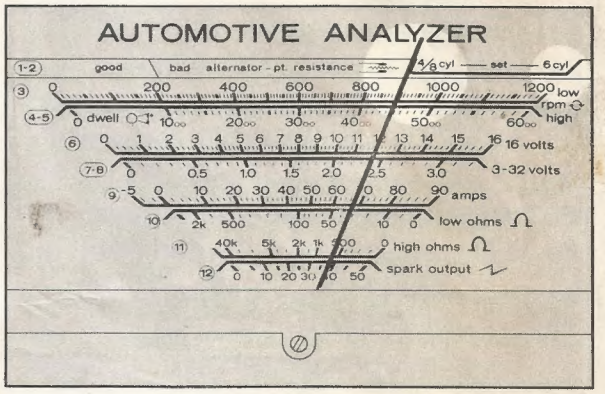
Note:

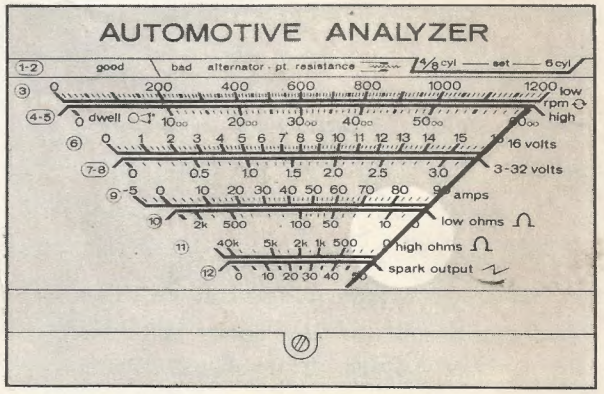
A. Calibrating the tester in either the LOW RPM, HIGH RPM or DWELL position automatically calibrates the other two.

B. To read 4 CYL dwell or RPM, double the 8 CYL reading.

OHMS POSITIONS

1. Turn Selector switch to the desired ohms position (HIGH-OHMS or LOW-OHMS). Press SET switch and adjust the OHMS calibrator until the meter pointer reads on the zero line of the ohms scale (right edge).



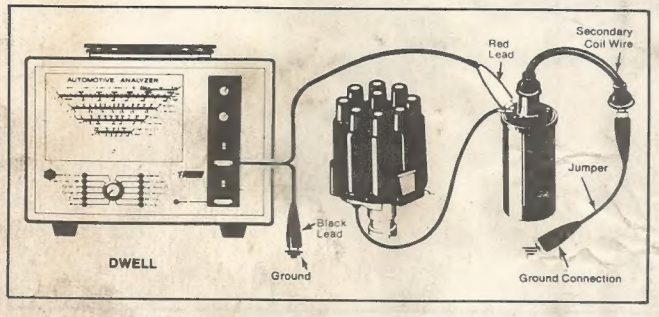


POINT RESISTANCE TEST

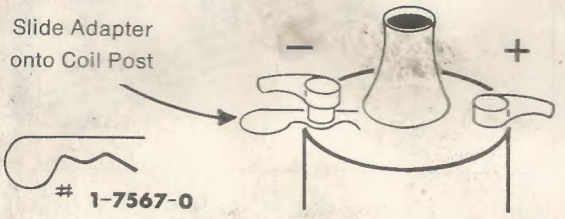
1. With engine stopped, remove the secondary coil wire from the distributor cap and ground it so that engine will not start. Connect tester as shown.
2. Turn Selector switch to DWELL position. Meter will read 45 or 60 degrees.
3. Turn engine ignition "on". If meter reads zero, points are open. Crank engine a fraction of a revolution at a time until meter reads toward the right. Points are now closed.

   Note: *When testing a double point system, block open one set of points while the other set is being tested.*
4. Turn Selector switch to POINT RES. position and read meter.
5. Turn engine ignition "off", and reconnect secondary coil wire.

Note: Ford primary circuit coil adapters (part #1-7567-0) are provided to simplify testing of Ford vehicles. Install as shown.

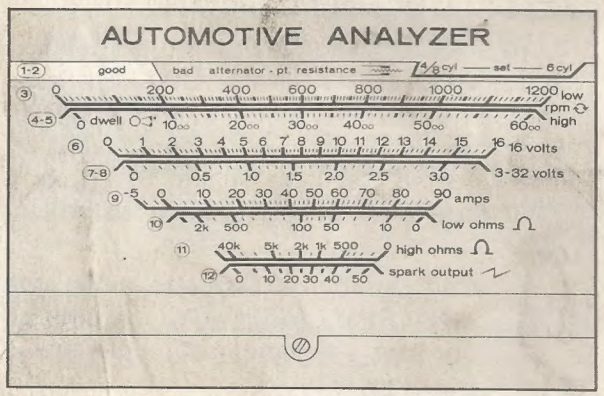


FORD PRIMARY CIRCUIT COIL ADAPTERS



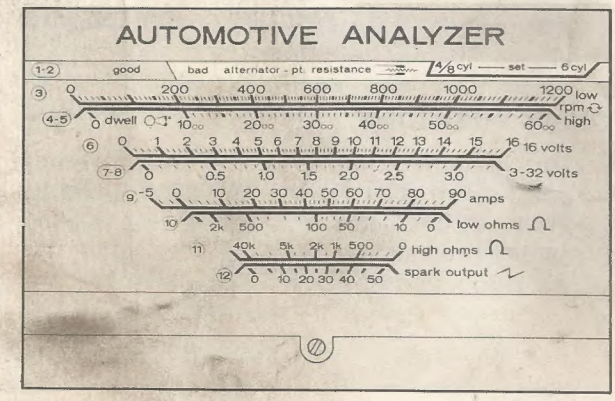
TEST RESULTS

Point Resistance Good

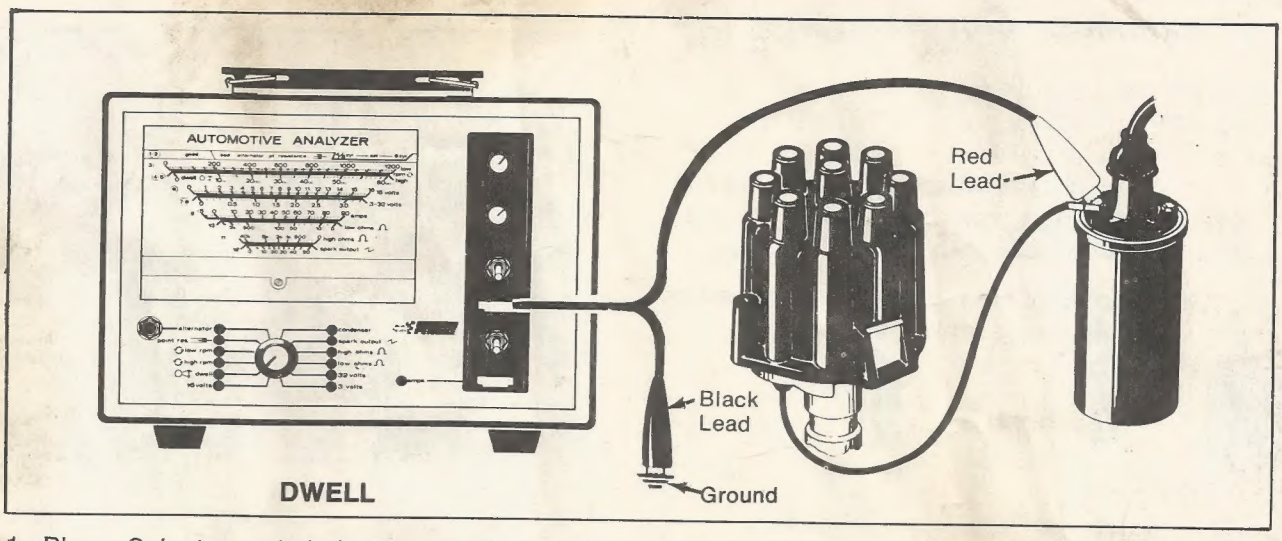


Point Resistance Bad,
Check For:

1. Burned ignition points
2. Poor lead connections
3. Improper point installation
4. Points misaligned
5. Defective ground pigtail
6. Poor distributor ground

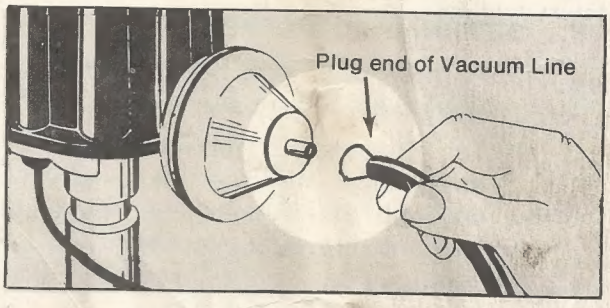


DWELL TEST



DWELL

1. Place Selector switch in the DWELL position and calibrate ANALYZER, page 3.
   Note: *Disconnect and plug the vacuum advance line from the distributor as on some distributors the dwell angle changes with the operation of the vacuum advance. Also, if vehicle is equipped with an advance retard solenoid, disconnect wire at the carburetor end.*
2. Connect test leads as shown.
3. Operate engine at Idle RPM and note meter reading. The reading should meet manufacturer's specifications for that engine. In the absence of manufacturer's specifications, the following table can be used as a general guide:

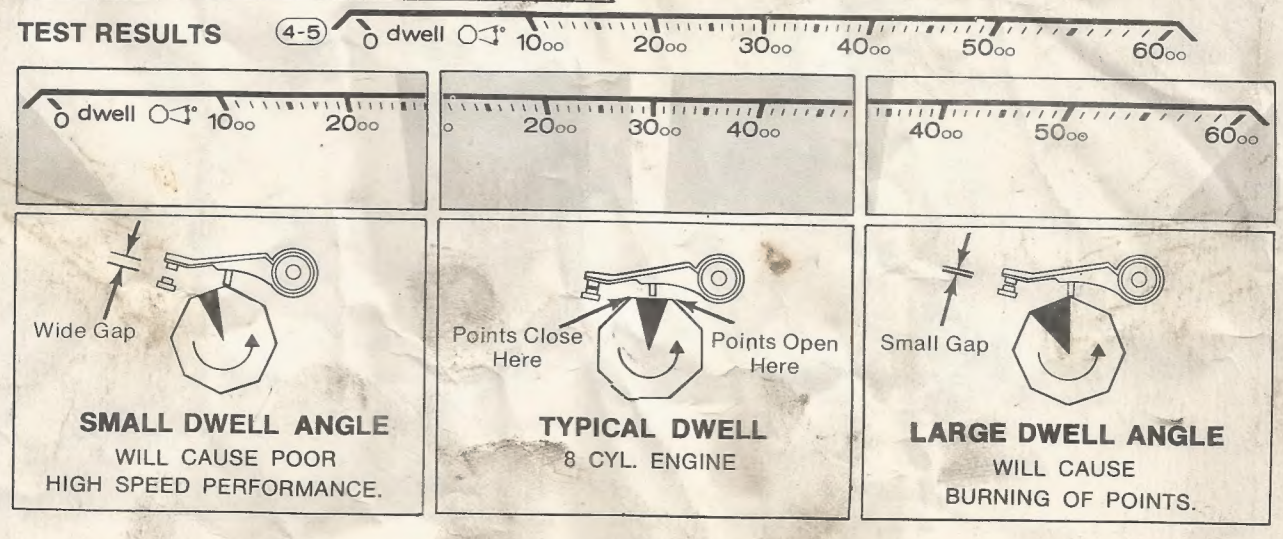


CYLINDER	DWELL ANGLE
8	28°-32°
6	35°-38°
4 (Multiply meter reading by 2)	50°-60°

Manufacturer's specifications can be found in the following publications:

1. Motor's Auto Repair Manual
2. Chilton's Auto Repair Manual
3. Automotive Electric Association Specification Cards or Handbooks
4. National Service Data Book

TEST RESULTS



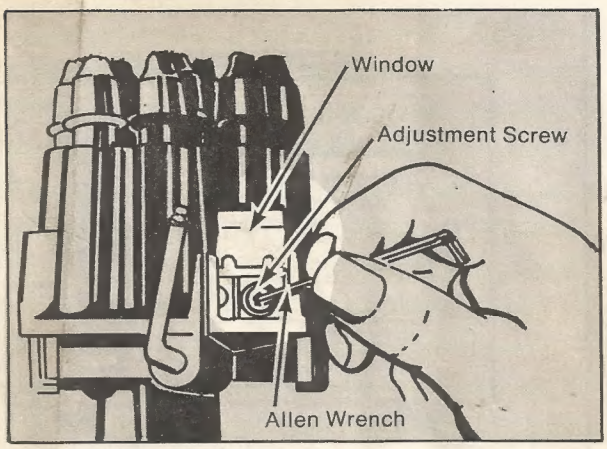
SMALL DWELL ANGLE
WILL CAUSE POOR HIGH SPEED PERFORMANCE.

TYPICAL DWELL
8 CYL. ENGINE

LARGE DWELL ANGLE
WILL CAUSE BURNING OF POINTS.

ADJUSTING DWELL

A. EXTERNAL ADJUSTMENT TYPE



1. With engine at idle and dwell meter connected, raise window, and insert Allen wrench into adjusting screw.
2. Turn adjusting screw until specified dwell is read on the meter.

B. INTERNAL ADJUSTMENT TYPE

1. Remove distributor cap and rotor, and ground the secondary coil wire.
2. Turn the engine ignition switch "on" and check the dwell reading while cranking the engine. It is normal for the meter to fluctuate slightly at low engine speed in which case an average reading must be taken.
3. To adjust dwell, loosen locking screw slightly and adjust gap by turning adjusting screw (figure **A**) or by inserting a screwdriver in the slotted hole (figure **B**) and turning the tool slightly left or right to obtain the specified gap. Tighten locking screw and recheck dwell while cranking.
4. Reassemble distributor and recheck dwell reading with engine operating at idle speed and with vacuum line disconnected from diaphragm of distributor.

Note: *It is important to recheck the ignition timing every time the breaker points are adjusted. A change of one degree in dwell causes a one degree change in timing.*

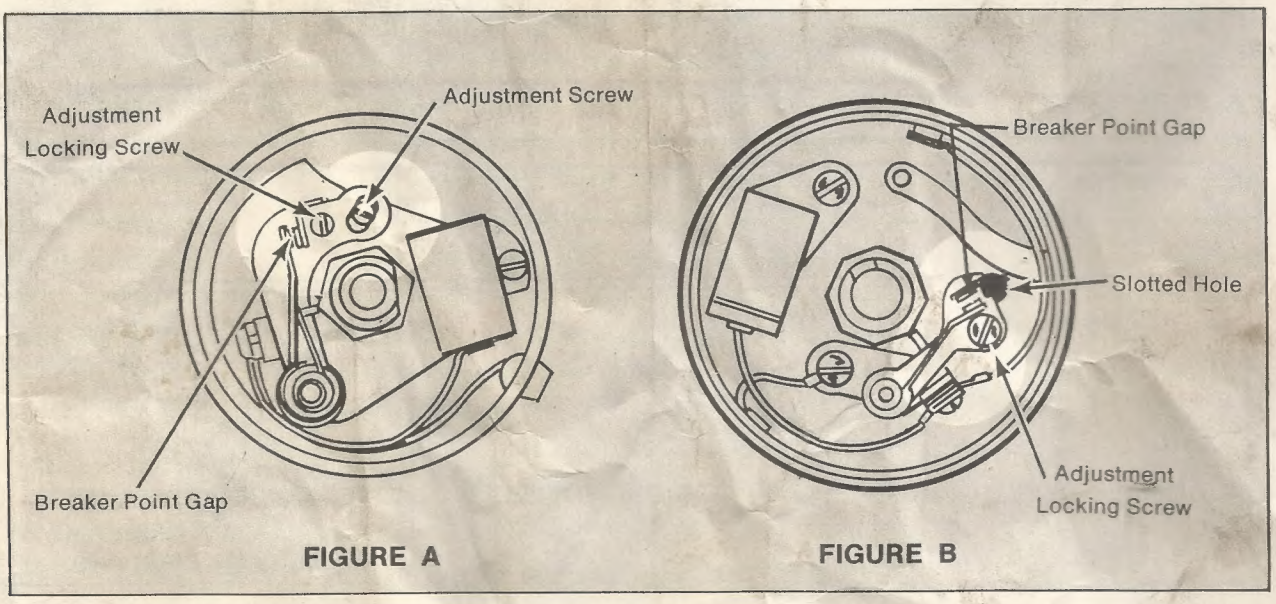
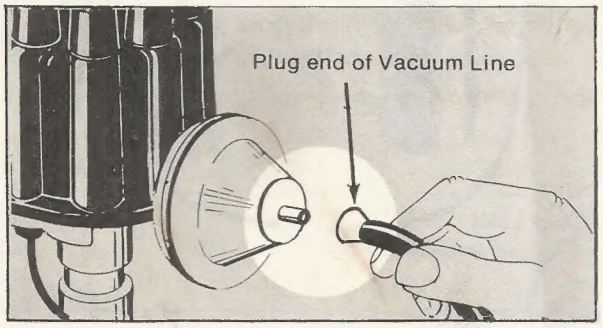


FIGURE A **FIGURE B**

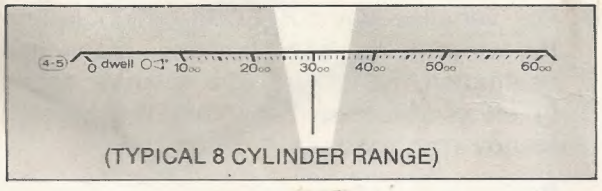
DWELL VARIATION TEST

1. Disconnect and plug the vacuum advance line from the distributor as on some distributors the dwell angle changes with the operation of the vacuum advance.



2. While watching the dwell meter for any change in reading, increase engine speed from idle to approximately 1200 RPM and then back to idle.

TEST RESULTS

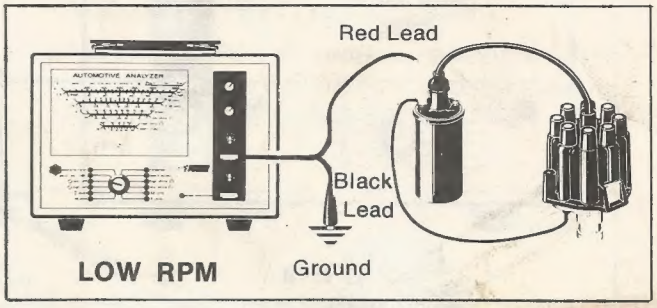


If Variation is more than 3 degrees check for:

1. Wear in distributor shaft and bushings.
2. Wear in breaker plate.

IDLE SPEED TEST

1. Turn Selector switch to the LOW RPM position, and calibrate the ANALYZER to the 4-8 or 6 cylinder position to agree with the engine being tested, page 3.
2. Connect ANALYZER as shown.



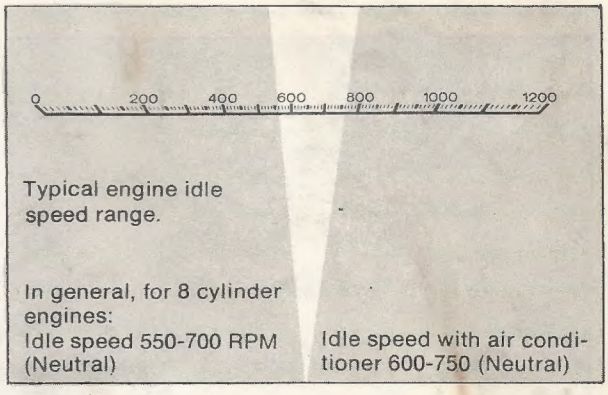
3. Start engine and read LOW RPM scale. Reading must agree with manufacturer's specifications.

Note: *For engines other than 6 or 8 cylinders the following chart may be used.*

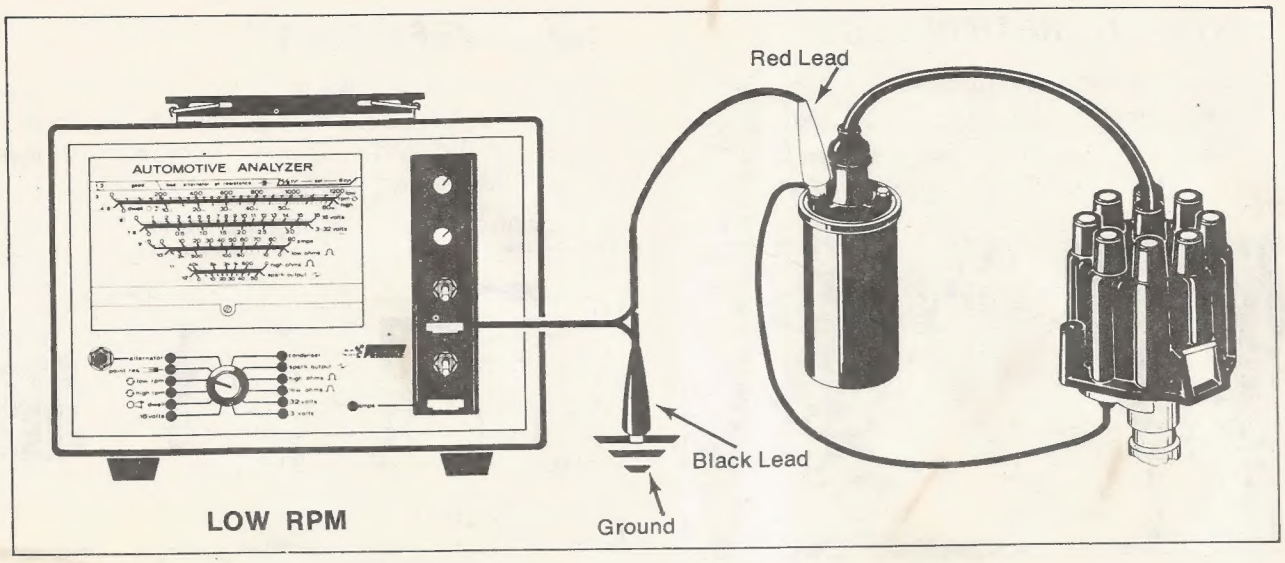
2 CYCLE ENGINES	4 CYCLE ENGINES
1 Cylinder—Meter Reading x 4	1 Cylinder—Meter Reading x 4
2 Cylinder—Meter Reading x 2	2 Cylinder—Meter Reading x 2*
4 Cylinder—Meter Reading x 1	4 Cylinder—Meter Reading x 2

*Based on engines without distributor, and having 2 point closures for every revolution.

TEST RESULTS



CARBURETOR ADJUSTMENT-IDLE RPM



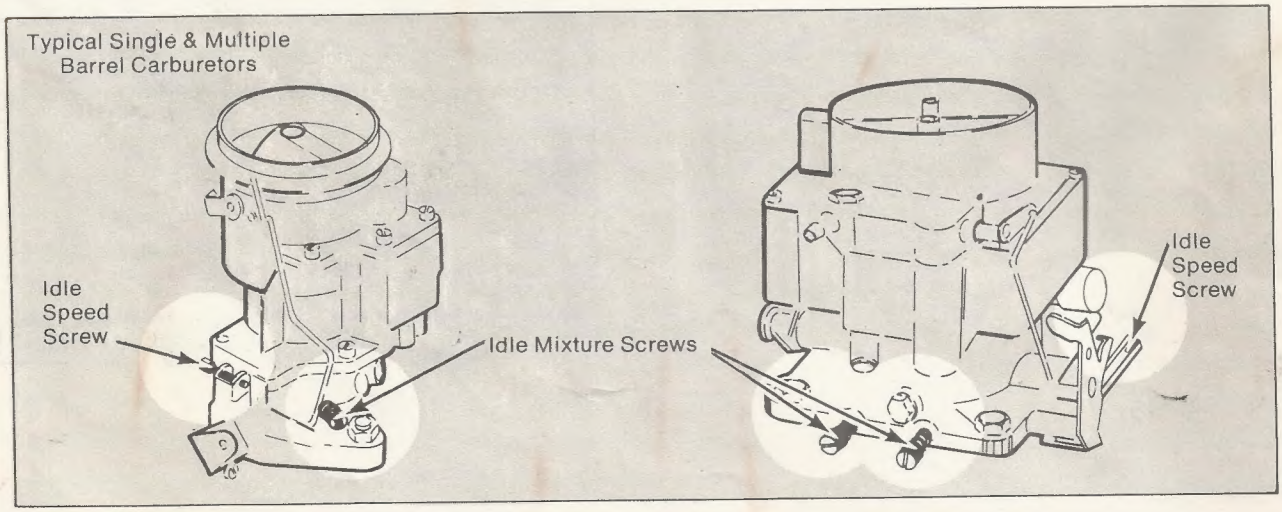
1. Turn ANALYZER Selector switch to LOW RPM position and calibrate, page 3.
2. Connect tester as shown.
3. Start engine and warm thoroughly to normal operating temperature.
4. Shut off the engine.
5. Turn the idle mixture screw(s) in (clockwise) until it (they) just bottom lightly. Back screw(s) out three complete revolutions or until a stop is felt (which ever occurs first).
6. Start the engine and let it idle one minute.
7. For vehicles with Emission Control Systems (ECS) refer to the decal in the engine compartment for idle adjustments.

Note: *On engines equipped with an air injection pump, disconnect air supply hoses to exhaust manifold, then proceed with normal idle mixture adjustment of carburetor, per decal.*

8. For vehicles without ECS (but including those vehicles with positive crankcase ventilation, PCV) turn idle mixture screw in either direction to obtain the highest steady rpm reading.

Note: *On multiple barrel carburetors, a slightly finer adjustment can be obtained by turning each mixture screw separately 1/8 turn either way to obtain maximum rpm as indicated by the tachometer.*

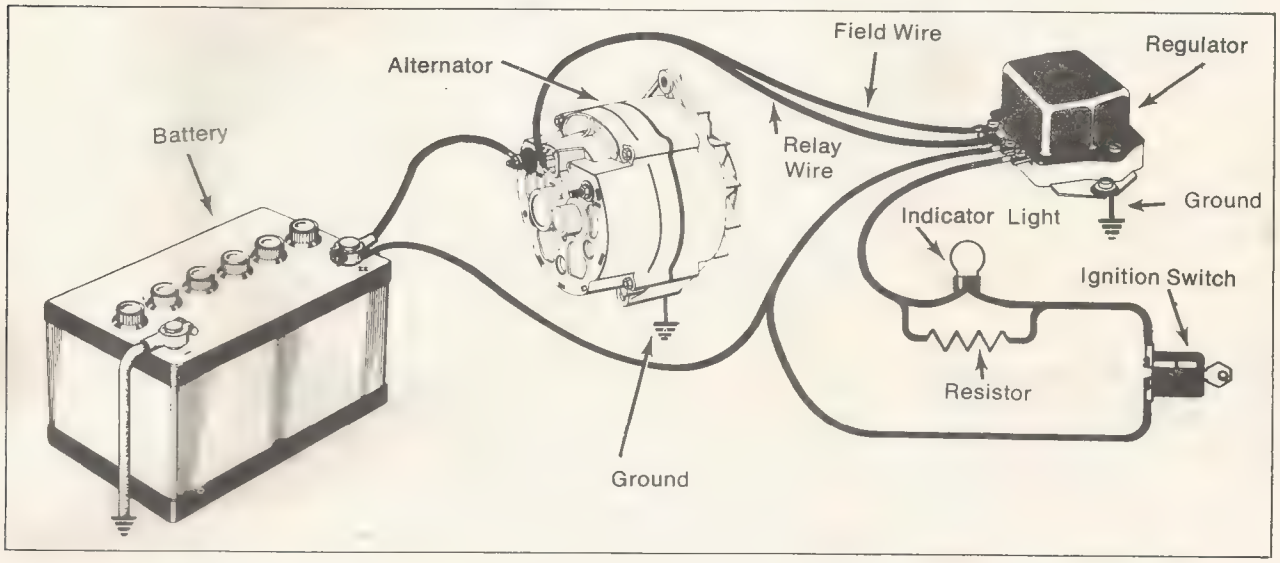
9. Readjust idle RPM with idle speed screw to manufacturer's specifications.



ALTERNATOR SYSTEMS (TYPICAL)

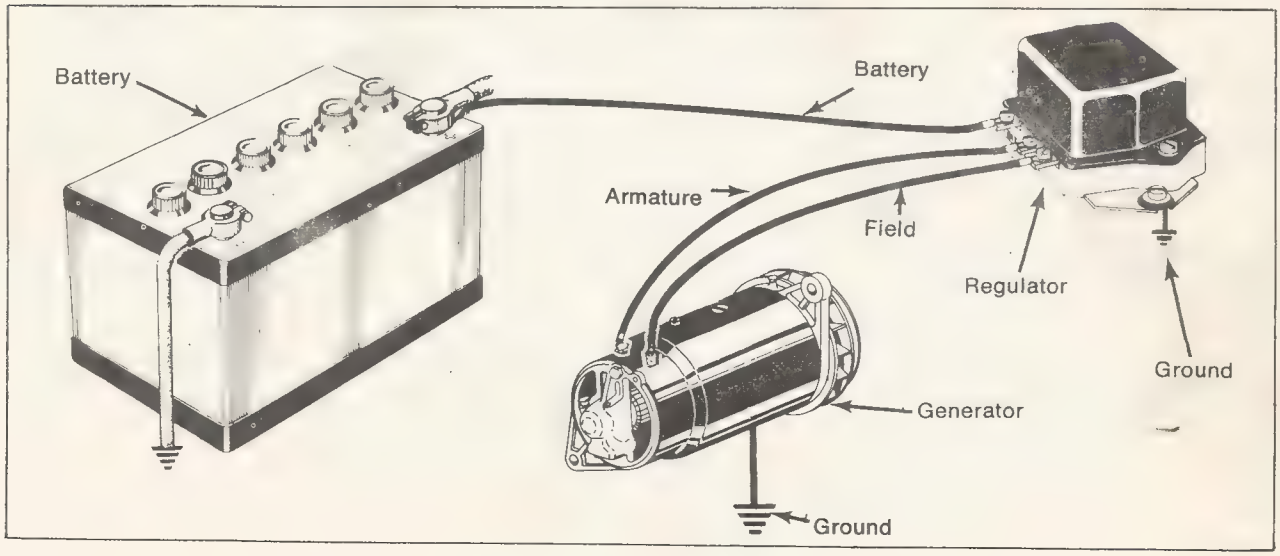
The automotive ALTERNATOR system consists of an alternator which generates alternating current, diodes that convert AC into DC, and a voltage regulator which regulates the output voltage of the alternator. A cutout relay is not required, since the diodes block the flow of current from the battery to the alternator. When working with an alternator, the following precautions must be taken:

1. Never polarize an alternator. It is not necessary.
2. Never connect battery backwards (reversed polarity). This will burn out the diodes.
3. Never short out or ground any terminals of the alternator or regulator except as shown in the test procedure.
4. Never operate alternator open circuited, (with output (BAT) terminal open).
5. Always observe proper polarity when charging battery or using a booster battery. Reversed polarity will damage the diodes in the alternator.



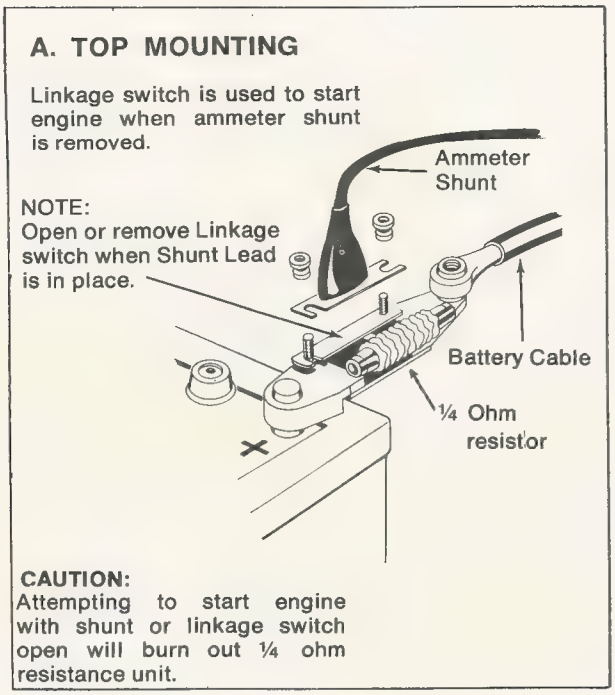
GENERATOR SYSTEMS (TYPICAL)

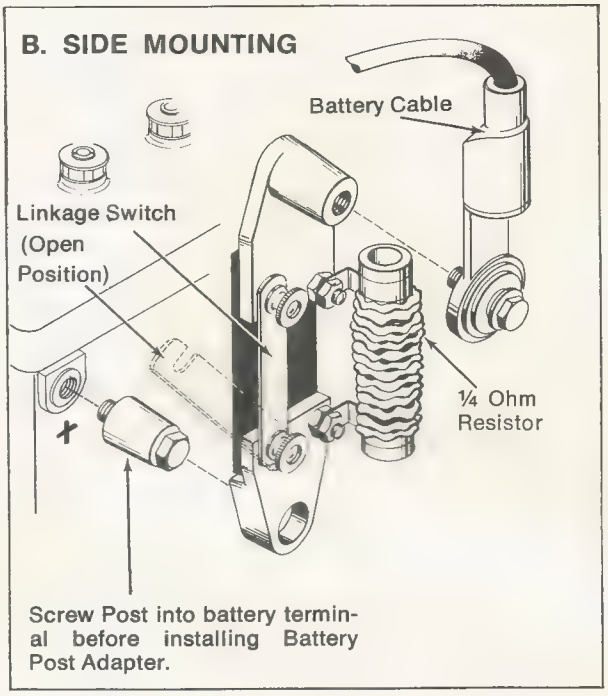
The automotive DC GENERATOR system consists of a generator which generates DC current and a voltage regulator which controls the output of the generator. The voltage regulator usually consists of 3 relays—the voltage regulating relay, the current regulating relay, and the cutout relay.



BATTERY POST ADAPTER INSTALLATION

The Battery Post Adapter, Model BP-2 has been designed and is supplied with the tester to facilitate the testing of all alternator and generator systems. The ¼ ohm resistance unit is installed permanently on the adapter to further simplify the testing of the regulator system.

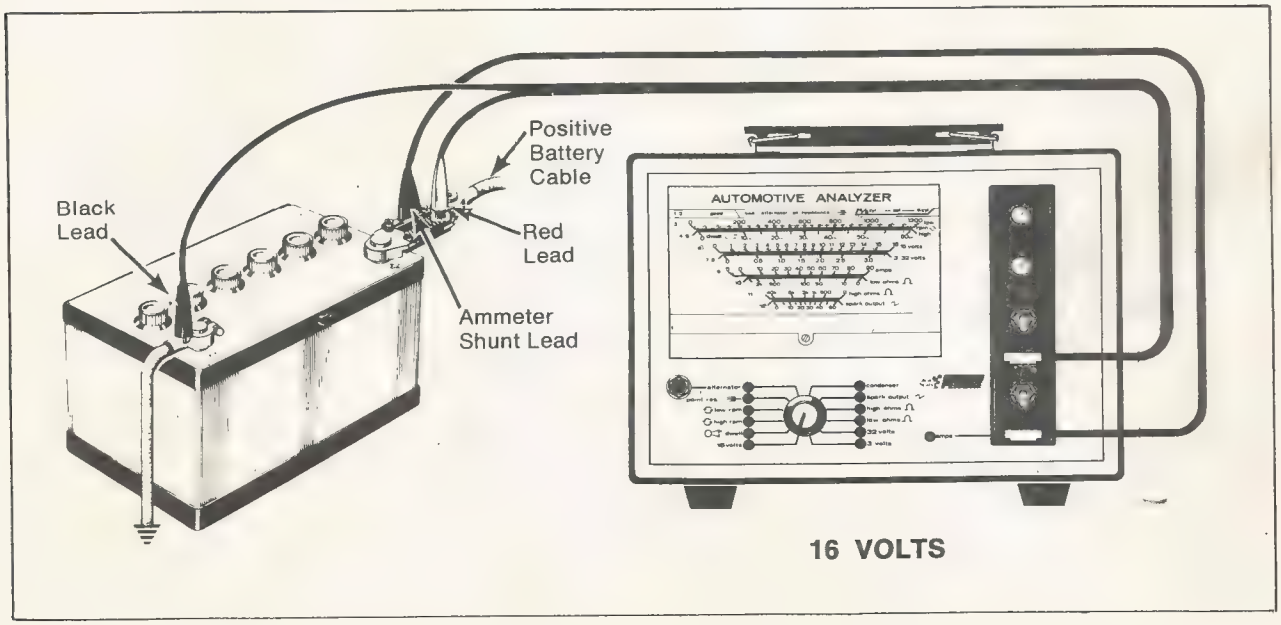




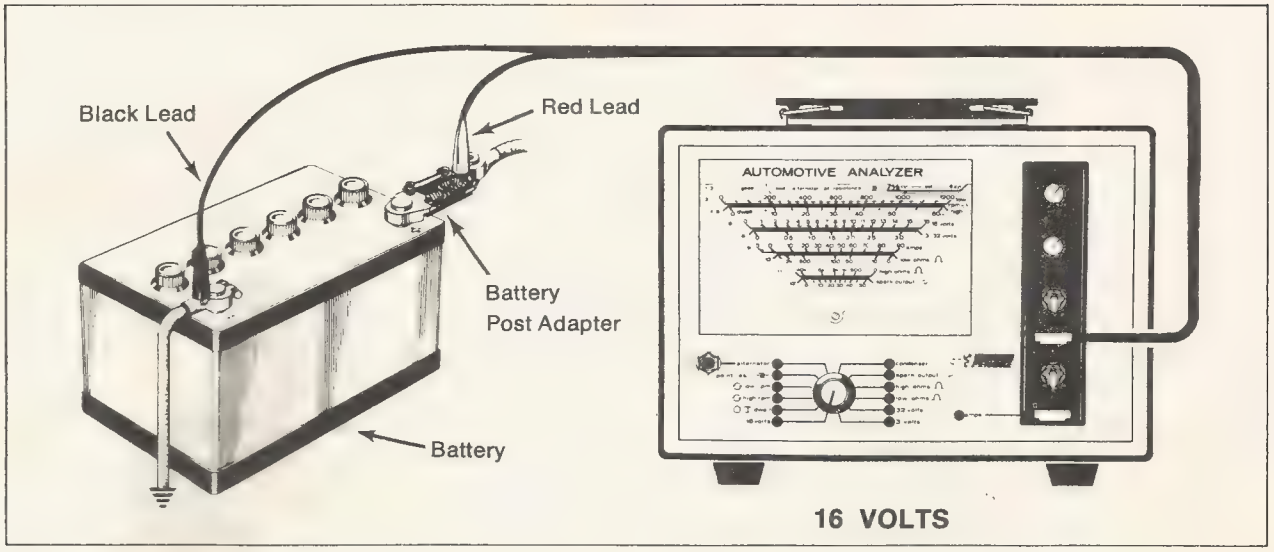
CHARGING SYSTEM HOOK-UP

1. Remove the positive battery cable from the battery, and connect Battery Post Adapter and test leads as shown.

Reconnect positive battery cable to the Battery Post Adapter.



ALTERNATOR SYSTEMS TESTS

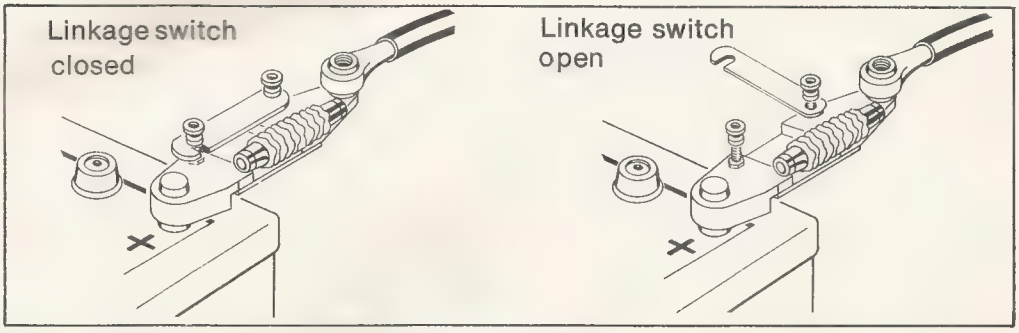


VOLTAGE REGULATOR TEST

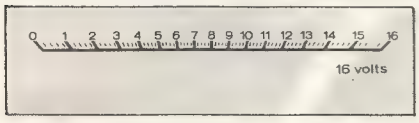
1. Connect red and black test leads as shown.
2. Turn Selector switch to the 16 VOLTS position (32 VOLTS position for 24 volt systems).
3. With Linkage switch closed start engine and operate at idle RPM. Open Linkage switch on the Battery Post Adapter.

Note: *Engine must be warm before this test can be performed. If necessary, operate engine with hood closed for 10 to 15 minutes to bring system up to operating temperature.*

4. Increase engine speed to approximately 1500 RPM while observing Voltmeter for highest voltage reading and compare with manufacturer's specifications.



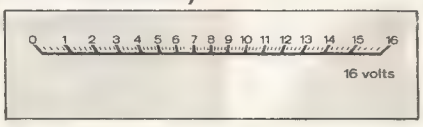
TEST RESULTS (TYPICAL 12 VOLT SYSTEM)



A. VOLTAGE NORMAL

Voltage regulator is good

System	Reading
6V	7.0—7.6V
12V	13.8—15.4V
24V	26.0—29.0V

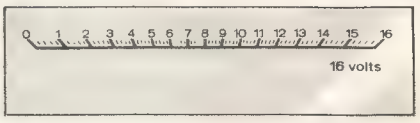


B. VOLTAGE LOW

Check For:

1. Loose fan belt
2. Defective voltage regulator
3. High resistance
4. Defective diodes
5. Defective field circuit
6. Defective alternator
7. Low voltage regulator setting

To find the faulty unit, proceed to the Alternator Current Output test, page 12.

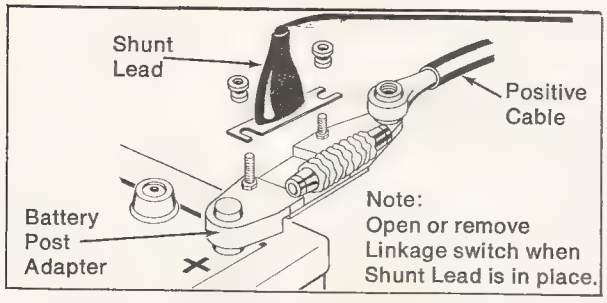


C. VOLTAGE HIGH

Check For:

1. Defective voltage regulator
2. High resistance in regulator ground circuit
3. Shorted or grounded field wire
4. High voltage regulator setting

ALTERNATOR CURRENT OUTPUT TEST



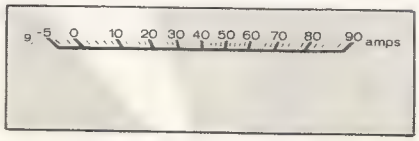
1. With engine stopped, install Battery Post Adapter, Shunt closed, as shown.
2. Place Test switch in the AMPS position (Selector switch may be in any position).
3. The alternator must deliver its maximum output in order to perform this test. Prepare the system for testing by grounding the secondary coil wire, turning on the headlights, and cranking the engine for 15 seconds. Turn off headlights and reconnect coil wire.

   Note: *If an auxiliary Load Unit is available, it is connected directly across the battery and turned on to draw maximum current from the charging system.*
4. Start engine, increase engine speed to approximately 2000 RPM and read 90 AMP scale. Reading must compare with manufacturer's specifications.

   Note: Add about 5 amps to current reading for conventional ignition system draw, 9 amps for transistor ignition system draw.

TEST RESULTS (TYPICAL 12 VOLT SYSTEM)

Reading within 5 amps of manufacturers rated output: alternator is OK



Low Reading, Check for:
1. Loose Fan belt.
2. Defective alternator
3. High circuit resistance (Alternator Circuit Resistance)
4. Proceed to Step 5.

Zero Reading:
1. Occasionally an open or broken field wire (leading from the regulator to alternator) can be at fault.
2. Voltage regulator can be defective.
3. Proceed to Step 5.

Step 5

If rated output current is not obtained, eliminate the regulator as shown on pages 13, 14 or 15. If there is doubt as to whether the alternator circuit is "A" or "B", refer to vehicle manual for procedure. Repeat steps 3 and 4 above.

CAUTION: When repeating Steps 3 and 4 with the regulator eliminated, the test should be performed quickly and the engine speed returned to idle.

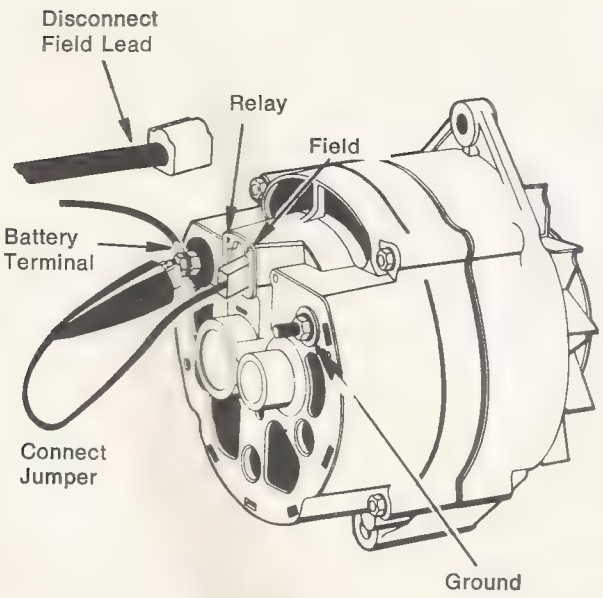
A. If rated current output is obtained, the alternator is good.

   Note: *If alternator is good and low regulator voltage was obtained in the Voltage Regulator test, the regulator is defective.*

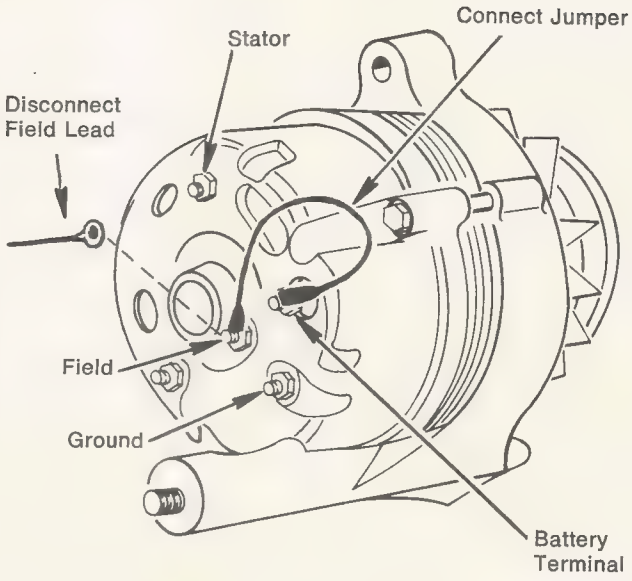
B. If rated current output is not obtained, the alternator is defective. Circuit Resistance Test, page **16**, should also be performed before condemning the alternator.

ELIMINATING VOLTAGE REGULATOR (Typical Types)

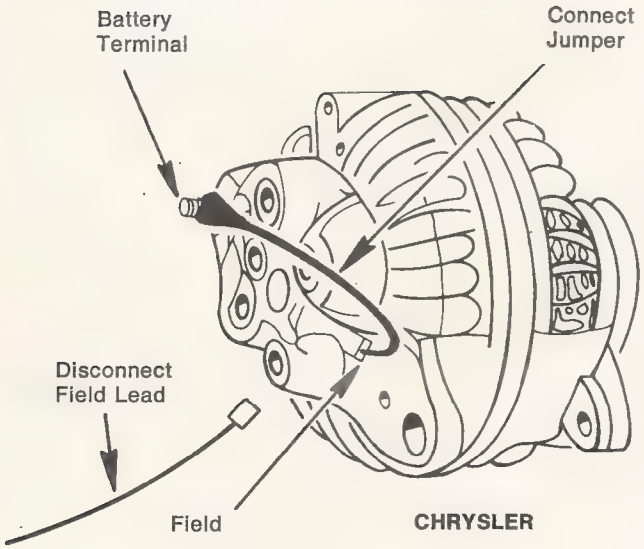
"B" Circuit



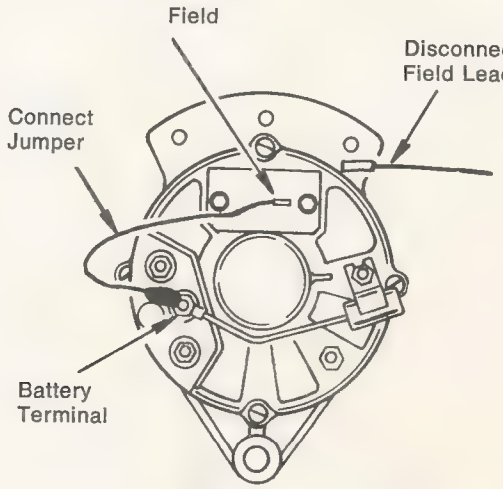
DELCO



FORD



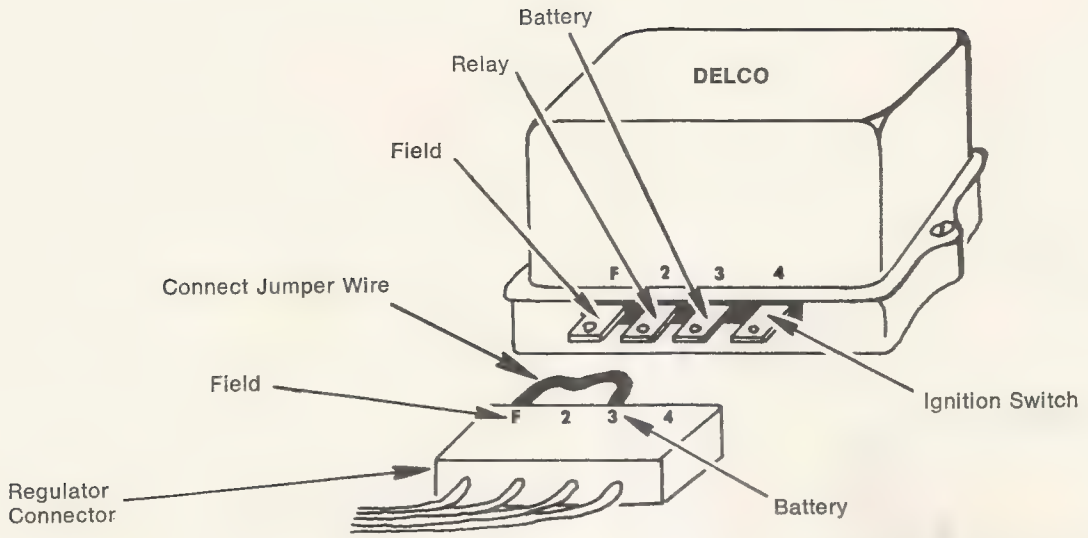
CHRYSLER

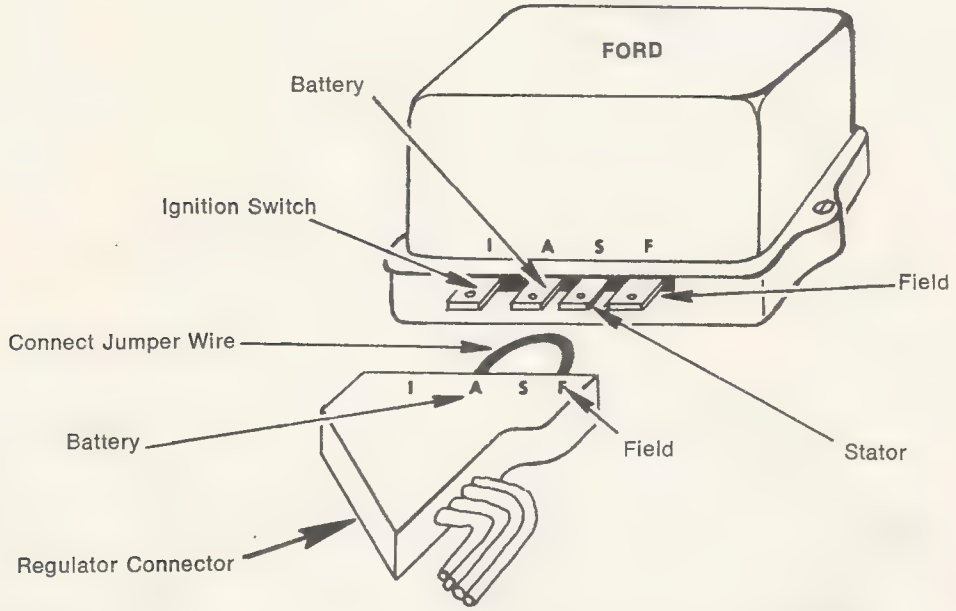


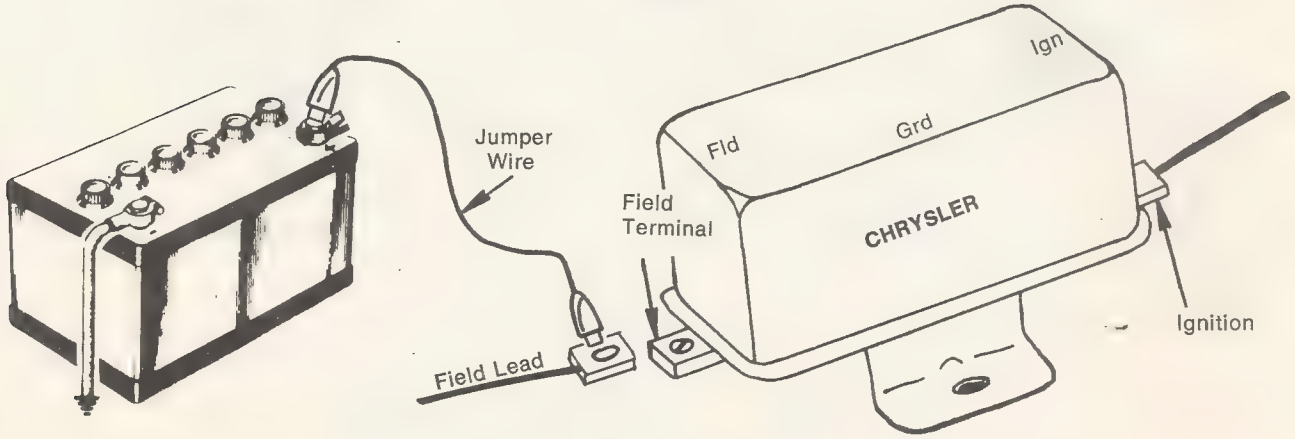
MOTOROLA

On some vehicles it may be inconvenient to connect the jumper wire at the alternator. In such a situation, remove the regulator connector from the voltage regulator and connect a jumper wire as illustrated on page 14.

"B" Circuit

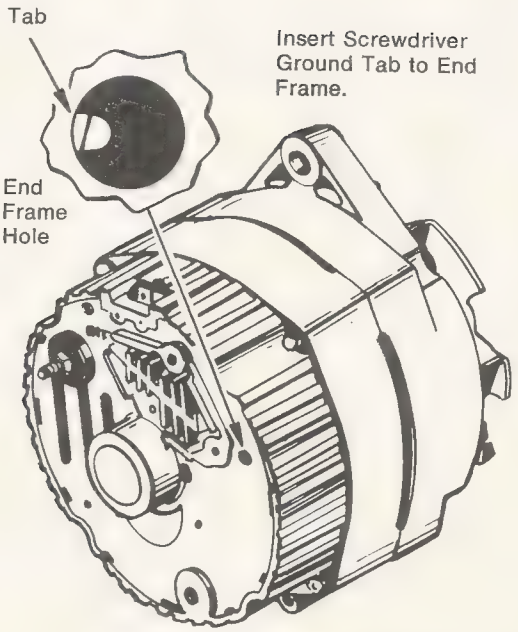




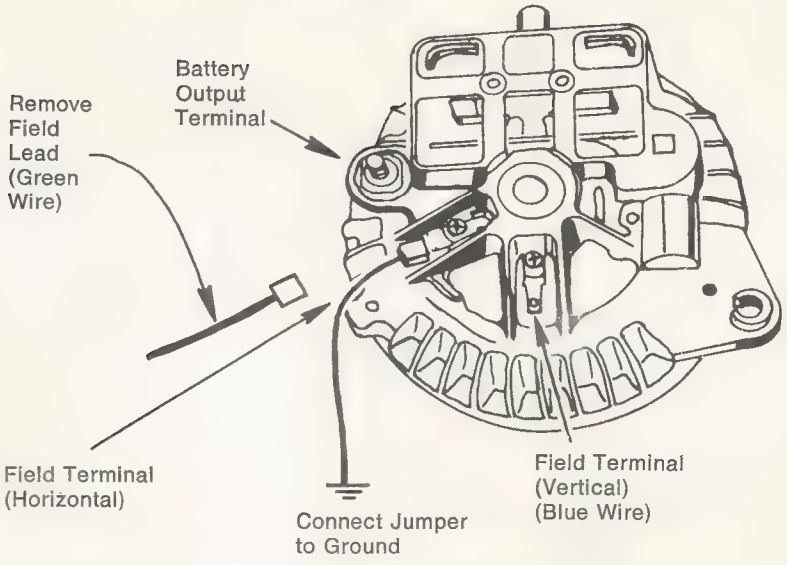


Remove field lead from field terminal.
Connect jumper wire from positive terminal of battery to the field lead.

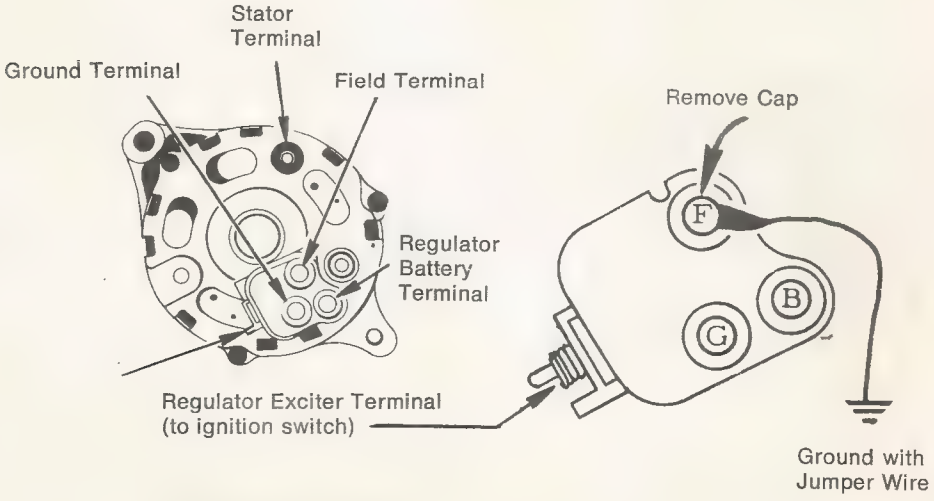
"A" Circuit (Electronic Voltage Regulator)



Delco:
Insert screwdriver not more than 1 inch in end frame hole, ground tab to frame with screwdriver. No additional adapter is needed.



Chrysler:
Remove field lead (green wire) from the alternator field terminal. Connect jumper wire from the alternator field terminal to ground.

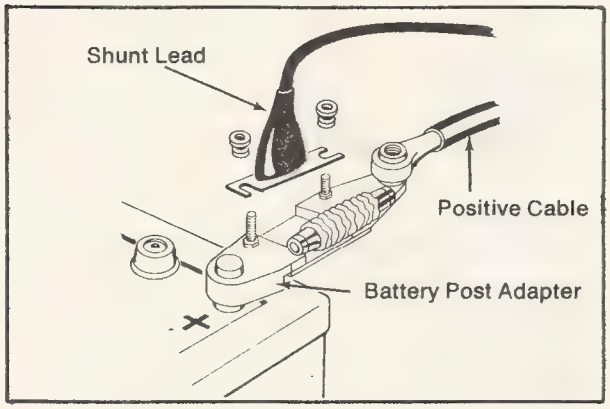


Ford:
Remove cap from the field terminal. Connect jumper wire to field terminal and ground.

INTEGRAL DESIGN

CIRCUIT RESISTANCE-ALTERNATOR SYSTEMS

1. Connect Battery Post Adapter and Shunt lead as shown. Shunt must be closed.



2. Turn Selector switch to the 3 VOLTS position and place Test switch in AMPS position.

3. Eliminate regulator as shown on page 13, 14 & 15.

4. Start engine and increase speed until ammeter reads 20 amps.

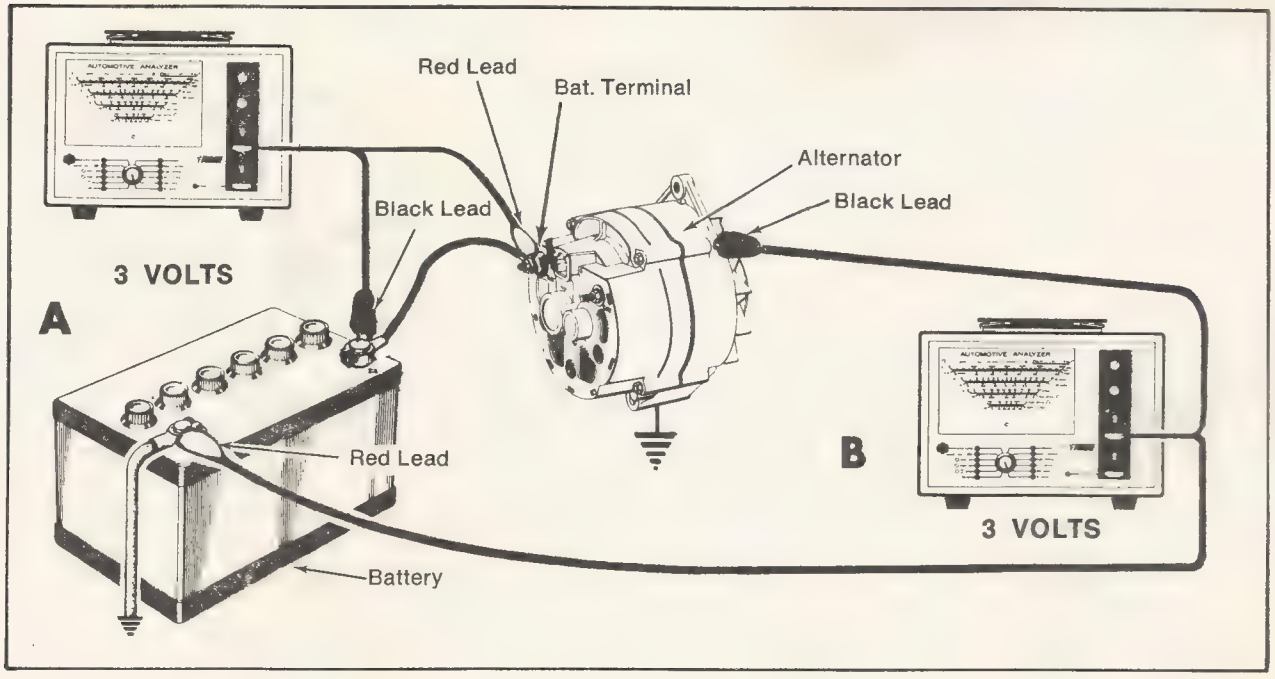
5. Place Test switch in the ALL OTHER TESTS position and measure voltage drop:

   A. IN THE INSULATED CIRCUIT, From the positive battery post to the BAT terminal on the alternator.

   B. IN THE GROUND CIRCUIT, From the grounded battery post to the alternator case.

   Note: *For positive ground systems the black and red leads should be reversed.*

6. Read voltage drops on 3 volt scale.



TEST RESULTS

A. A voltage drop of more than 0.3 volts in the insulated circuit **(A)** indicates excessive resistance.

B. A voltage drop of more than 0.1 volts in the ground circuit **(B)** indicates excessive resistance.

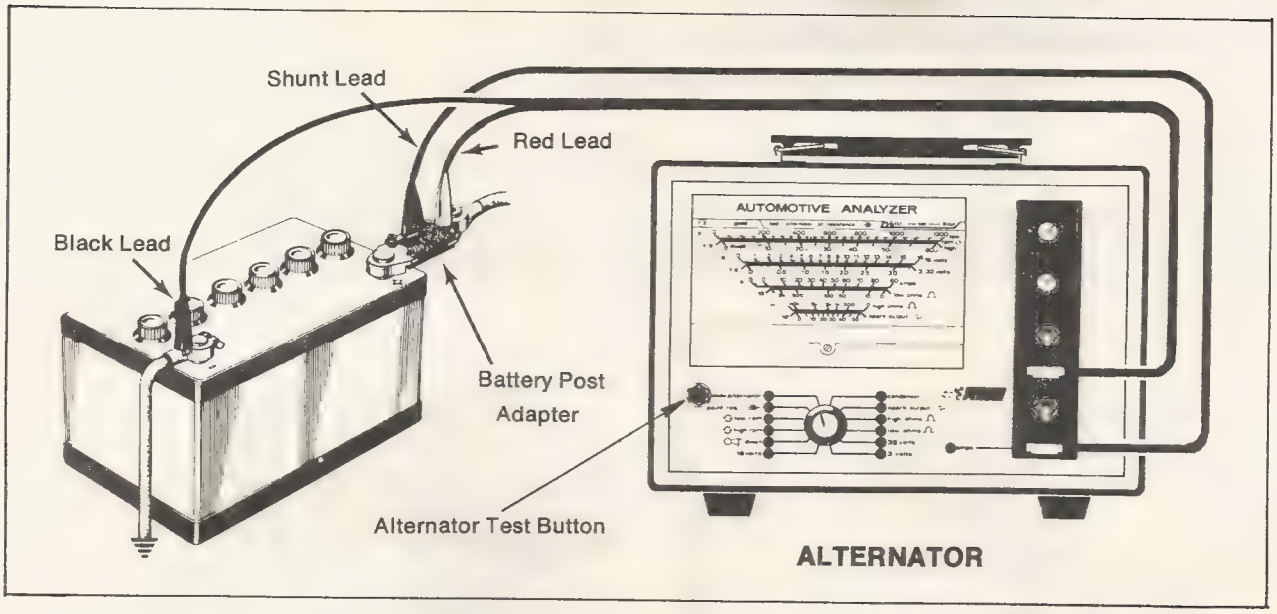
Note: *On Chrysler alternator systems, a static field circuit resistance test should be made.*

A. Remove primary ignition wire from the ignition ballast resistor.

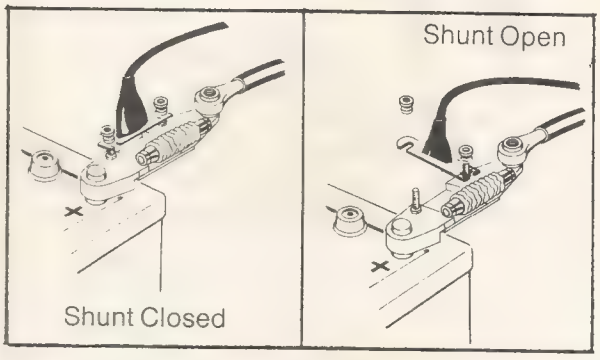
B. Turn ignition switch "on".

C. Measure voltage drop from the positive battery post to the field terminal of the regulator. A voltage drop of more than .55 volts indicates excessive field circuit resistance.

ALTERNATOR DIODE TEST

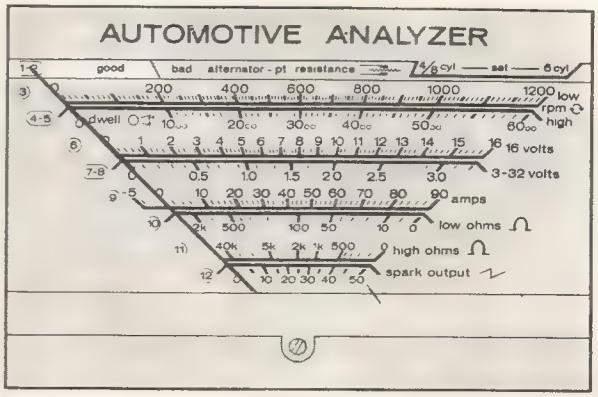


1. Connect Battery Post Adapter and test leads as shown.
2. Turn Selector switch to the ALTERNATOR position.
3. With Shunt closed on Battery Post Adapter, start engine.
4. Open Shunt, turn headlights on and operate engine at approximately 1200 RPM.
5. Press Alternator Test button and read ALTERNATOR scale.



TEST RESULTS

Alternator good.



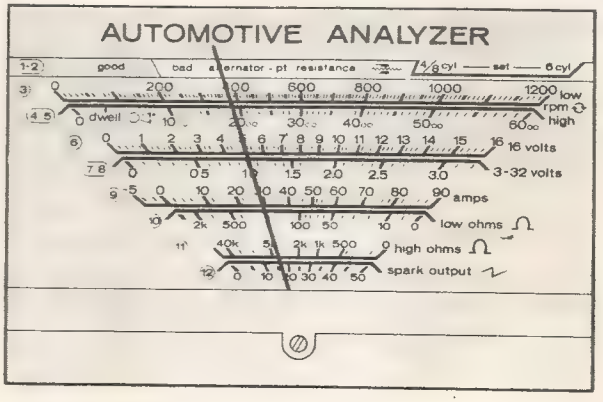
Note: *A zero reading also indicates a good alternator, if the regulator voltage has been checked and found to be normal.*

Alternator bad.

Check For:

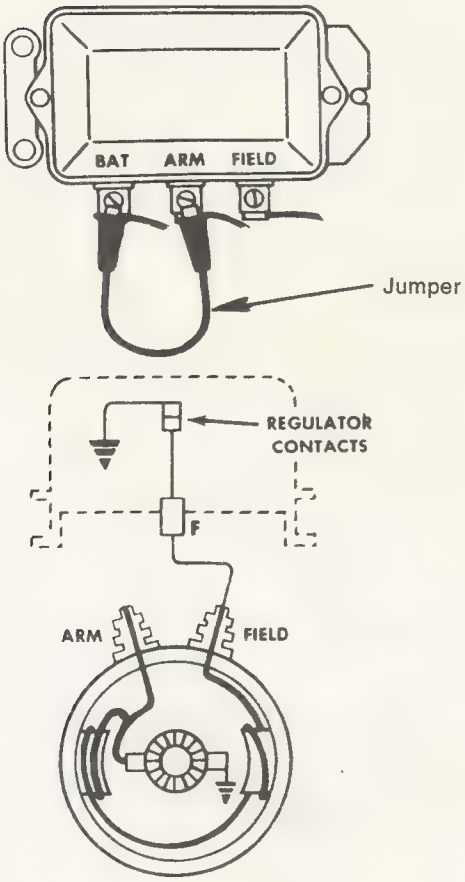
1. One or more shorted or open diodes.
2. Open or shorted stator winding.

Note: *The system must be charging before the Alternator Diode test can be performed. Therefore, always perform the Voltage Regulator test, page 11 before making this test.*



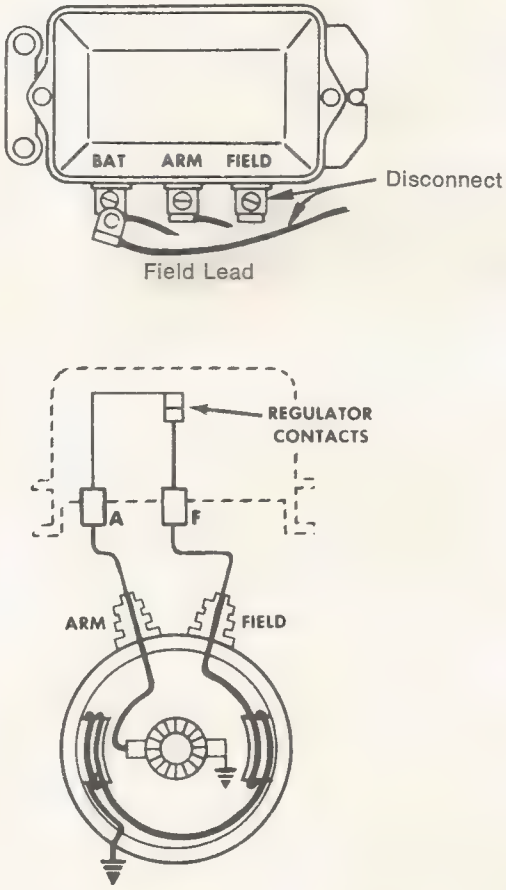
GENERATOR SYSTEMS – D.C. GENERATOR POLARITY

Whenever the leads have been disconnected from a generator or after a generator has been repaired, it must be polarized. This will insure correct polarity and cause current to flow in the proper direction to the battery. It is important that the generator be polarized BEFORE starting the engine. An accessible place to polarize the generator is at the voltage regulator terminals as shown in the illustration.



POLARIZATION OF "A" CIRCUIT GENERATORS

Momentarily touch a jumper lead from the regulator battery (B) terminal to the regulator armature (ARM) (GEN) terminal, with the engine stopped.

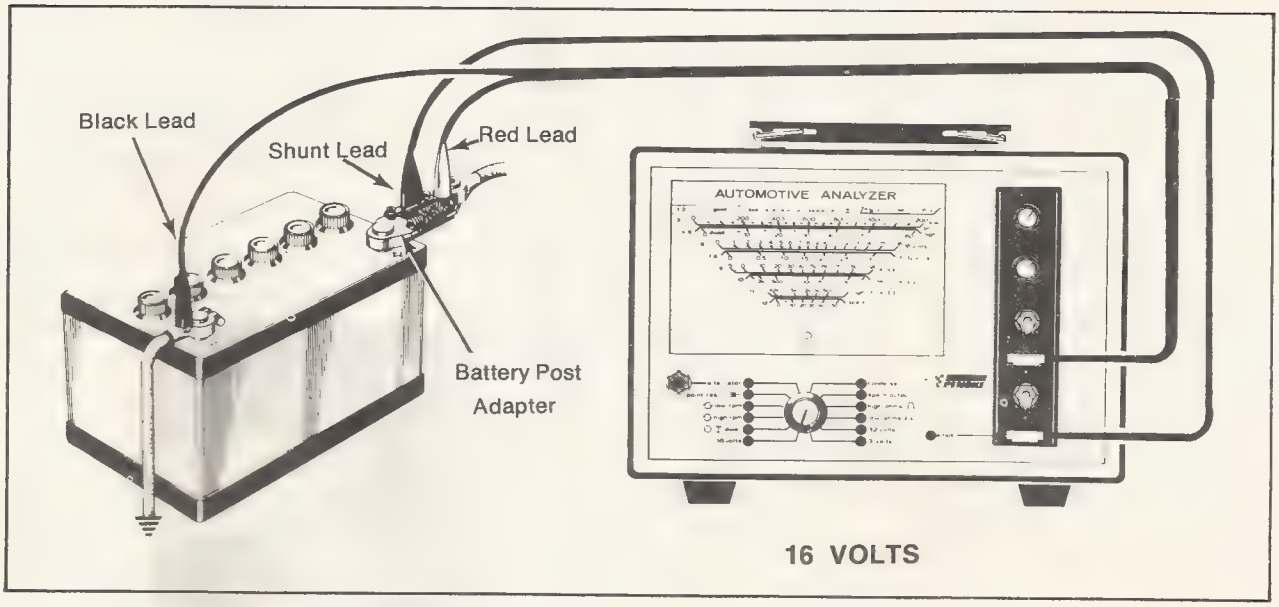


POLARIZATION OF "B" CIRCUIT GENERATORS

Remove field wire from the voltage regulator field (F) terminal.
Momentarily touch the field wire to the battery (B) terminal of the voltage regulator with the engine stopped.

Note: To determine if the circuit is "A" or "B" consult the manufacturer's manual.

GENERATOR VOLTAGE REGULATOR TEST

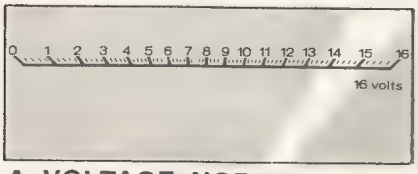


1. Connect Battery Post Adapter and test leads as shown.
2. Turn Selector switch to the 16 VOLTS position (32 VOLT position for 24 volt systems).
3. With Shunt closed on Battery Post Adapter, start engine and operate at idle RPM.

Note: *Engine must be warm before this test can be performed. If necessary, operate engine with hood closed for 10-15 minutes to bring system up to operating temperature.*

4. Open Shunt on Battery Post Adapter.
5. Increase engine speed to approximately 1500 RPM while observing voltmeter for highest voltage reading.
6. Note voltmeter reading and compare with manufacturer's specifications.

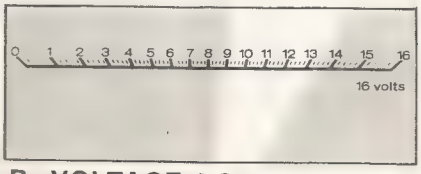
TEST RESULTS (TYPICAL 12 VOLT SYSTEM)



A. VOLTAGE NORMAL

Voltage regulator is good

System	Reading
6V	7.0—7.6V
12V	13.8—15.4V
24V	26.0—29.0V

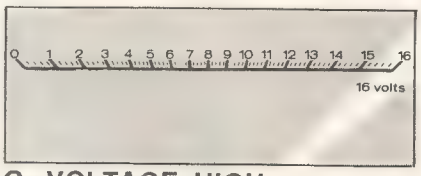


B. VOLTAGE LOW

Check for:

1. Loose fan belt
2. Defective voltage regulator
3. High resistance
4. Defective field circuit in generator
5. Low voltage regulator setting

To find the faulty unit, proceed to the Generator Current Output test, page 20.



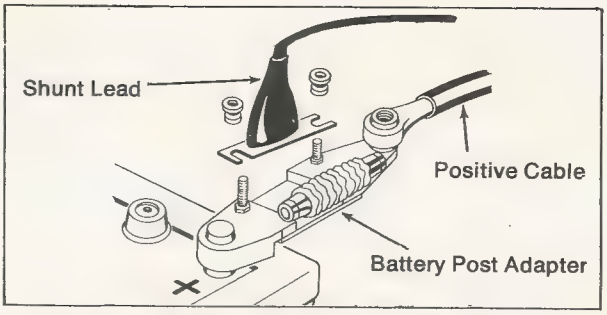
C. VOLTAGE HIGH

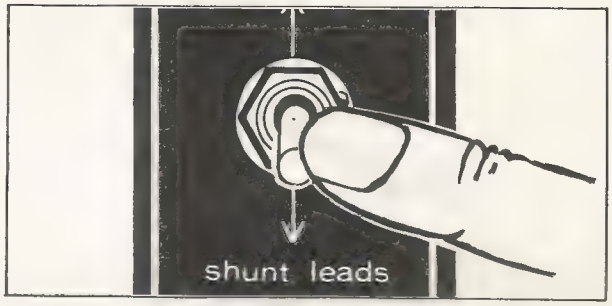
Check for:

1. Defective voltage regulator
2. Generator field shorted inside generator by-passing the regulator.
3. High resistance in regulator ground circuit
4. High voltage regulator setting

GENERATOR CURRENT OUTPUT TEST

1. With engine stopped, install Battery Post Adapter, Shunt closed, as shown.
2. Place Test switch in the AMPS position (Selector switch may be in any position).
3. The generator must deliver its maximum output in order to perform this test. Prepare the system for testing by grounding the secondary coil wire, turning on the headlights, and cranking the engine for 15 seconds. Turn off headlights and reconnect coil wire.
4. Start engine, increase speed to approximately 1600 RPM and read the 90 AMP scale. Reading must compare with manufacturer's specifications.





TEST RESULTS

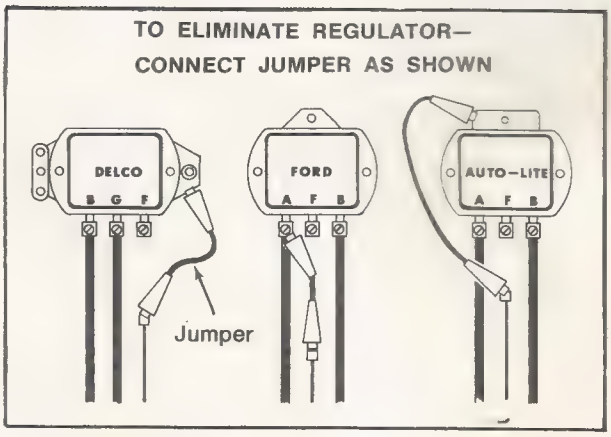
NORMAL READING	ZERO READING	LOW READING
Reading within 5 amps of rated output: generator is OK	A. Defective voltage regulator. B. Open field wire between generator and regulator. C. Brushes stuck in brush holder. D. Open connections within generator.	A. Loose fan belt. B. High resistance within generator. C. Low current regulator setting. D. Defective voltage regulator.

If rated output current is not obtained, stop the engine and eliminate the regulator by connecting a jumper wire as shown.

Start the engine and slowly increase speed until rated output current or 2000 RPM is reached.

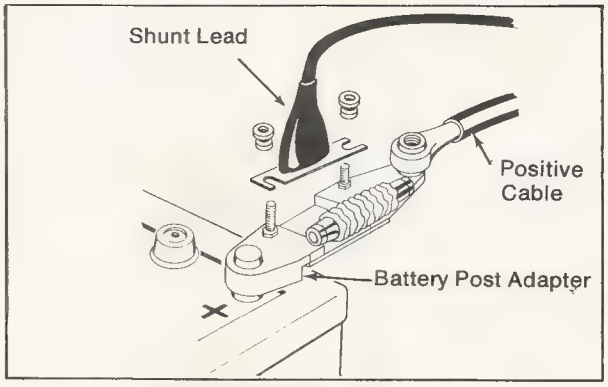
CAUTION: Do not exceed rated output current of generator or 16 volts.

A. If the current indicated on meter rises to within 5 amps of rated output at approximately 2000 RPM, the generator is good. Perform Current Regulator and Circuit Resistance tests.
B. If the current does not rise to the given value, the generator is defective. Perform Circuit Resistance test before making any replacement.



CIRCUIT RESISTANCE—GENERATOR SYSTEMS

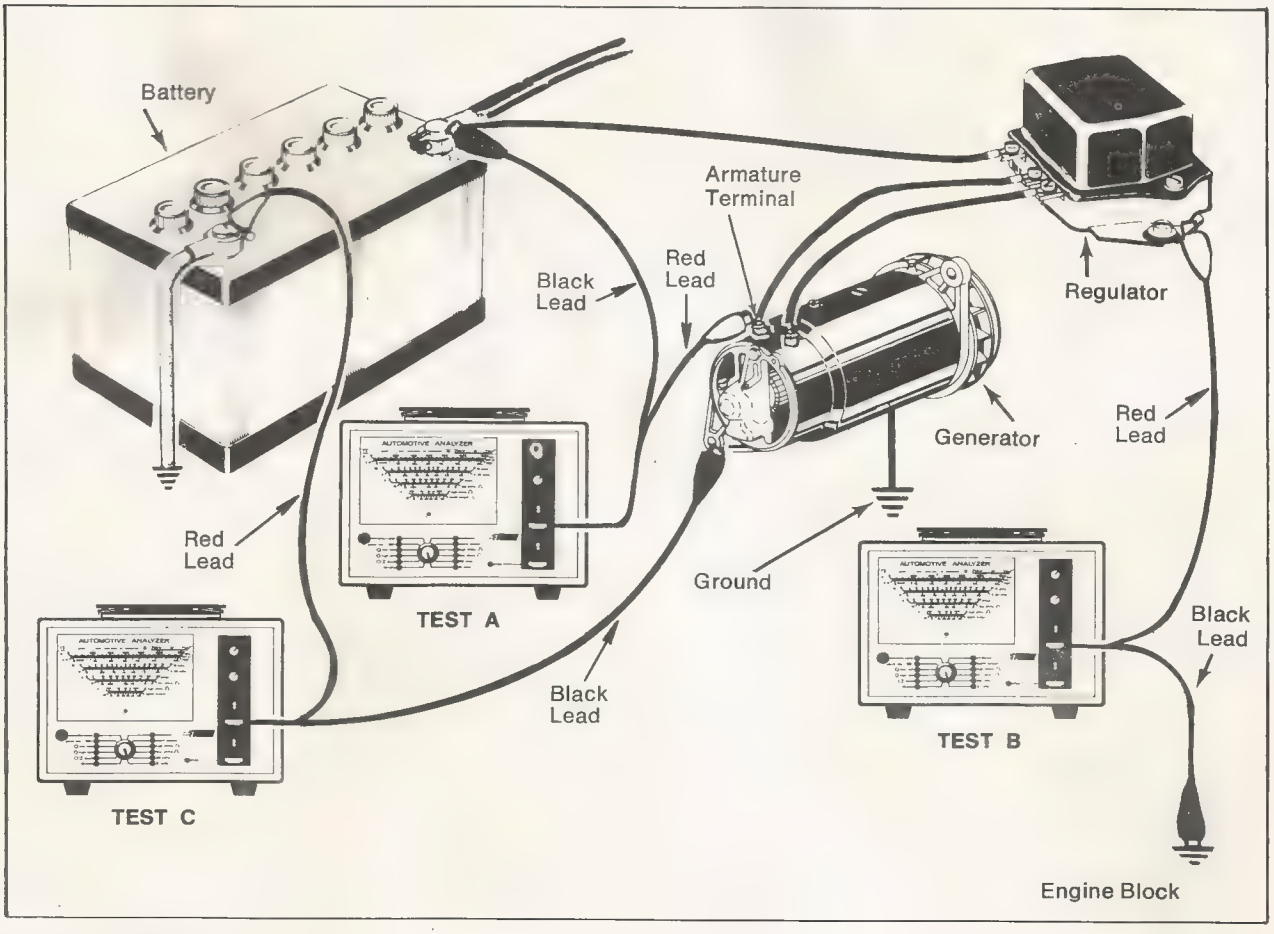
1. Connect Battery Post Adapter and Shunt lead as shown. Shunt must be closed.
2. Turn Selector switch to the 3 VOLTS position, and place Test switch in the AMPS position.
3. Eliminate regulator as shown on page 20.
4. Start engine and increase speed until ammeter reads 20 amps.
5. Place Test switch in the ALL OTHER TESTS position and measure voltage drop:
   A. IN THE INSULATED CIRCUIT
      From the generator armature terminal to the positive battery post.
   B. IN THE GROUND CIRCUIT
      From the regulator case to the engine block.



   C. IN THE GROUND CIRCUIT
      From the generator case to the grounded battery post.

      Note: *For positive ground systems the black and red leads should be reversed.*

6. Read voltage drops on the 3 volt scale.



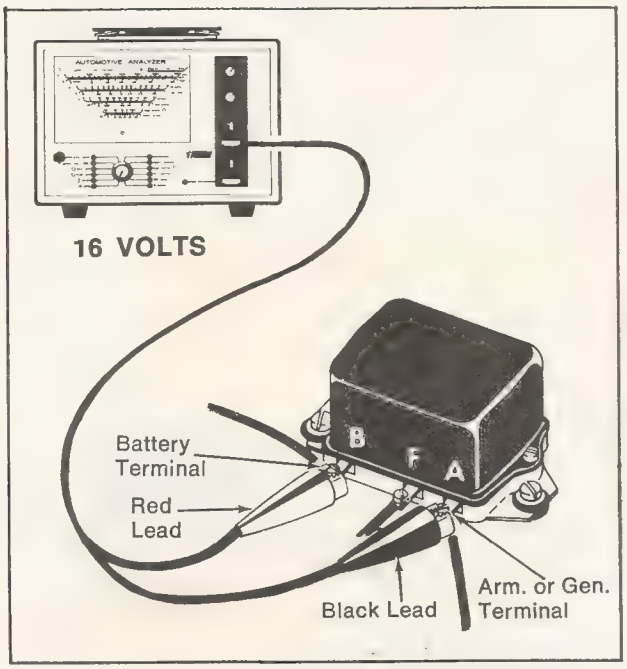
TEST RESULTS

A voltage drop of more than:
0.8 volts in A
0.1 volts in B
0.1 volts in C
indicates excessive circuit resistance.

CUT OUT RELAY— GENERATOR SYSTEM

The battery will discharge thru the generator, if the cutout relay points do not open when the engine is turned off. Also, if the cutout relay points do not close when the engine is running, the battery will not receive a charge. The following is a check of the regulators cutout relay operations.

1. Connect test leads as shown.



2. Set Selector switch to 16 VOLTS position (32 VOLTS position for 24 volt system).
3. With engine off, the voltmeter should read battery voltage.
4. Start engine and operate at approximately 700 RPM. Voltmeter should read zero (0) volts.
5. Turn engine off. Voltmeter should again read battery voltage.

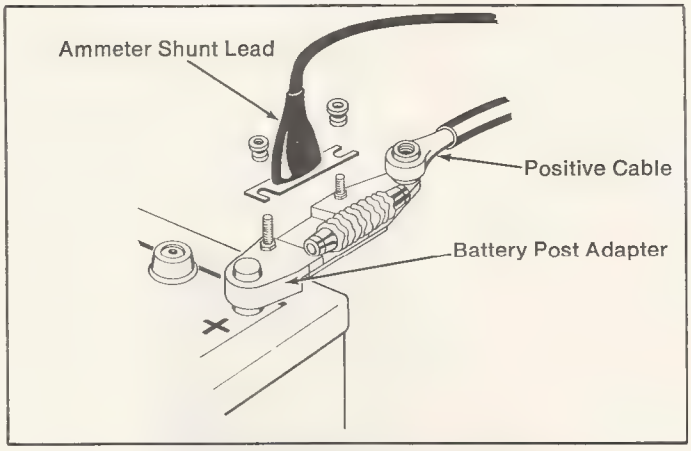
TEST RESULTS

Engine off—A reading much lower than battery voltage indicates cutout relay points are stuck closed. This condition will discharge the battery.

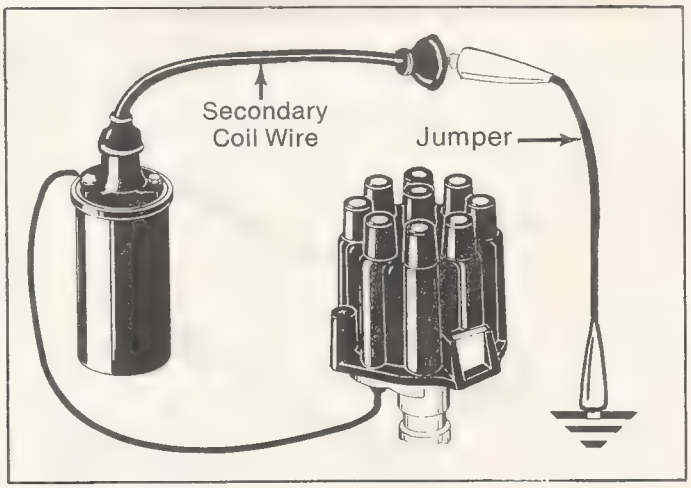
Engine Running—A reading of battery voltage indicates cutout relay points are not closed, and the charging system is not functioning properly. Check for defective cutout relay coil or points. Also, perform Voltage Regulator and Generator Output tests.

CURRENT REGULATOR— GENERATOR SYSTEM

1. Connect ammeter shunt as shown. Ammeter shunt must be closed.



2. Place Test switch in the AMPS position.
3. Remove secondary coil wire from the distributor and ground it.



4. Crank engine for 20—30 seconds.
5. Replace secondary coil wire into distributor.
6. Start engine. Increase engine speed to approximately 2000 RPM and quickly observe ammeter reading.
7. Compare ammeter reading with current relay specifications.

TEST RESULTS

As engine speed is increased, the ammeter reading should increase to a specified current relay setting and then hold that reading as the speed is further increased.

If the ammeter reading is higher or lower than specified, the current relay is defective or improperly adjusted.

BATTERY CAPACITY TEST

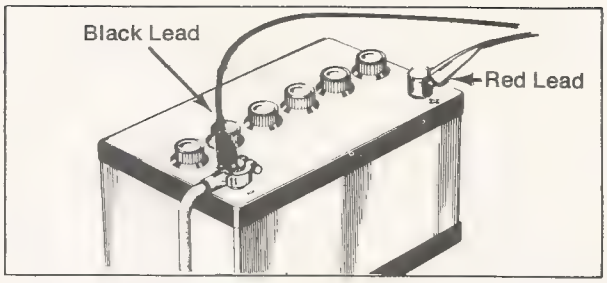
1. To perform this test, the battery must be fully charged. Each cell should have a minimum reading of 1.240 on a hydrometer. The engine should be at operating temperature.

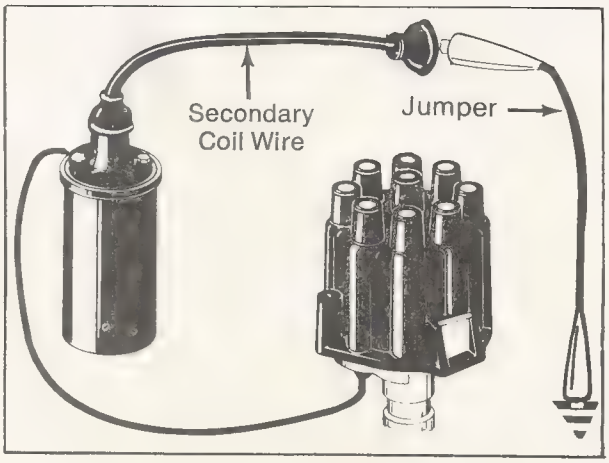
2. Turn Selector switch to 16 VOLTS position (32 VOLTS position for 24 volt systems).

3. Connect voltmeter leads to battery terminals (red lead to positive terminal, black lead to negative terminal).

4. Ground secondary coil wire so that engine will not start.

5. Crank engine for 15 seconds while watching meter. Starter should crank freely.



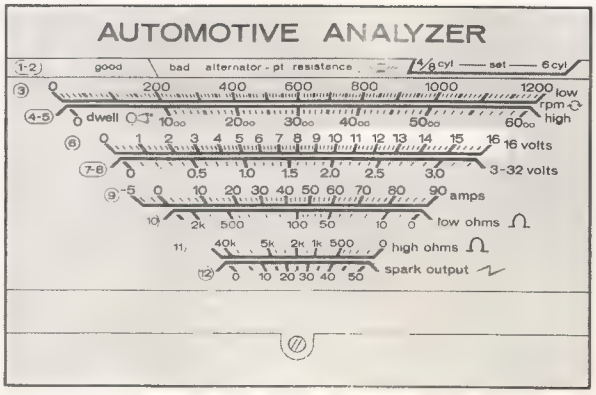


TEST RESULTS (TYPICAL 12 VOLT SYSTEM)

GOOD

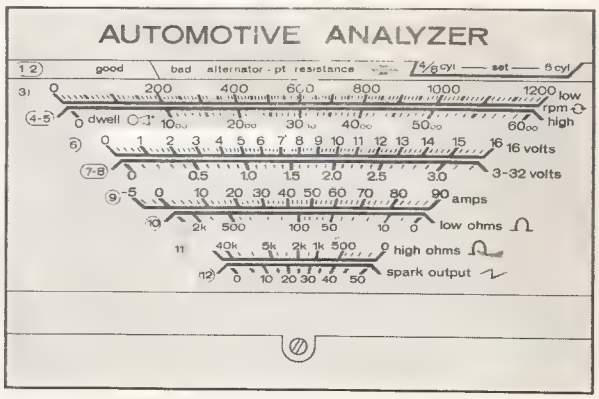
A reading of 9.6 volts or higher indicates a battery and starter system that are functioning normally

Note: *On 6 volt systems, a reading higher than 4.8 volts indicates a good battery and starter system.*

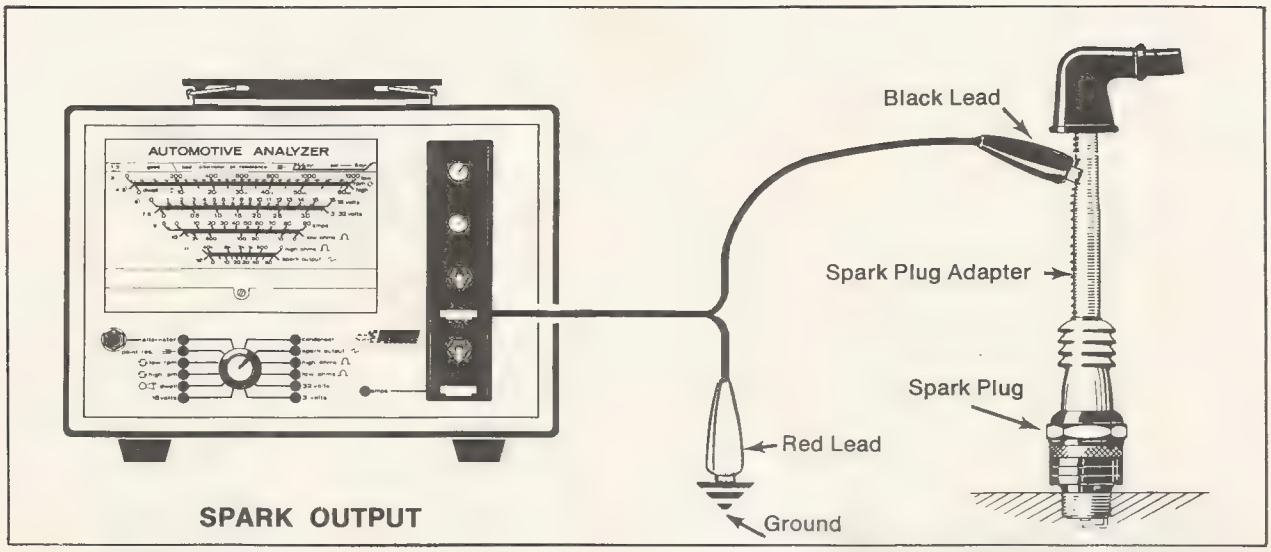


LOW

Check For:
1. Weak battery
2. Defective cables
3. Defective connections
4. Defective switch or starter
5. Excessive engine drag

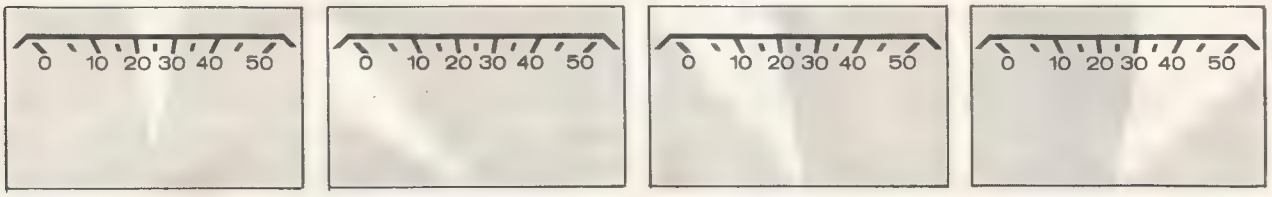


COIL POLARITY AND IGNITION TEST



1. Install adapter on spark plug.
2. Connect the red test lead to a convenient ground.
3. Turn Selector switch to the SPARK OUTPUT position.
4. Start engine and operate at approximately 1200 RPM.
5. Touch the black test lead to the adapter and note meter reading.
6. Repeat test on each spark plug.

TEST RESULTS



NORMAL READING

If the readings on all plugs are about equal, the system is O.K.

REVERSED READING

CHECK FOR:

1. Reversed coil connections
2. Battery installed backwards

LOW READING

CHECK FOR:

1. Bad spark plug cables
2. Fouled or shorted spark plugs
3. Defect in the primary of the ignition system
4. Defective distributor cap

HIGH READING

CHECK FOR:

1. Wrong coil
2. Ballast resistor not wired in coil circuit
3. Non-resistor spark plug cables
4. Hi-performance coil

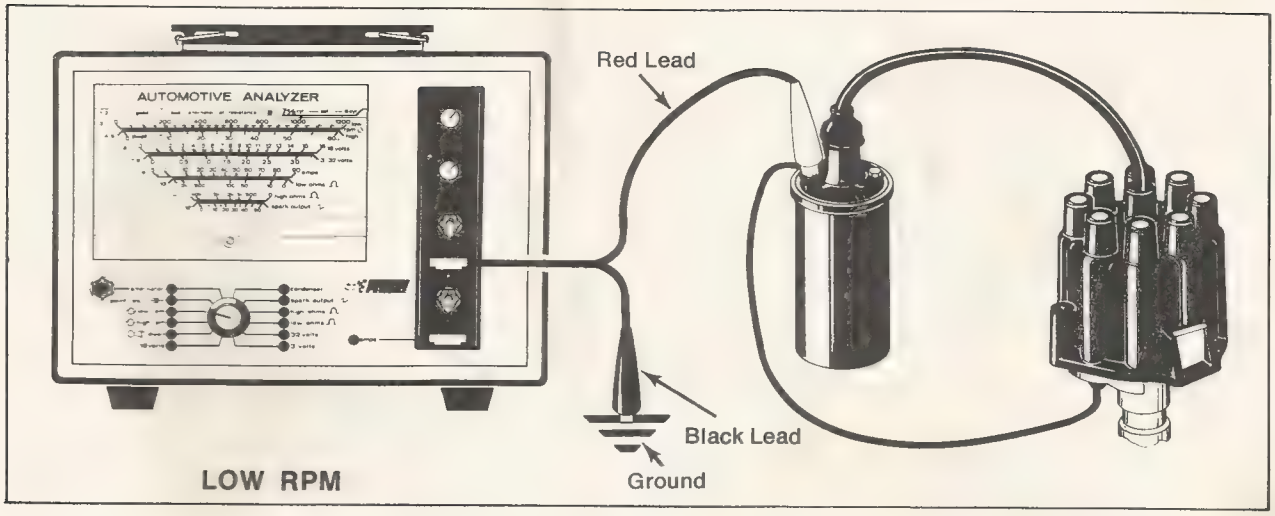
Should an erratic reading result at any plug(s), disconnect vacuum line to the distributor before condemning spark plug wires.

A. If reading is still erratic, spark plug wire is defective.

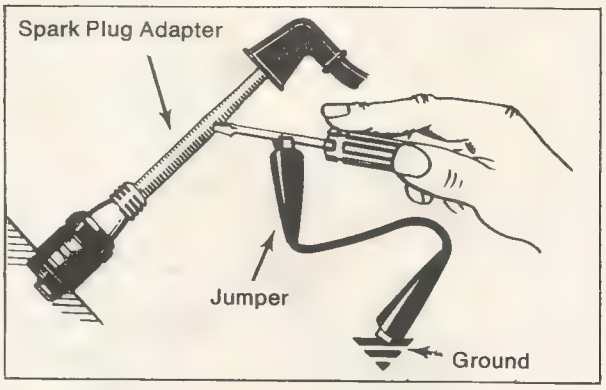
B. If reading steadies, the erratic reading may have been due to crossfire in the distributor cap.

Note: *Normally functioning transistorized ignition systems will ordinarily give a lower reading than conventional systems.*

CYLINDER BALANCE TEST

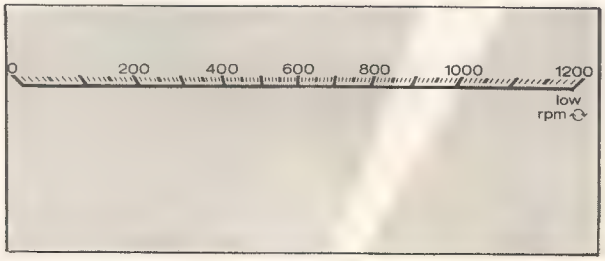


1. Install adapter on spark plug.
2. Turn Selector switch to the LOW-RPM position and calibrate ANALYZER as shown on page 3.
3. Connect test leads as shown.
4. Start engine and operate at 1000 RPM.
5. Using a jumper lead and a screwdriver, ground out spark plug and note a change in rpm.
6. Repeat test at each spark plug.



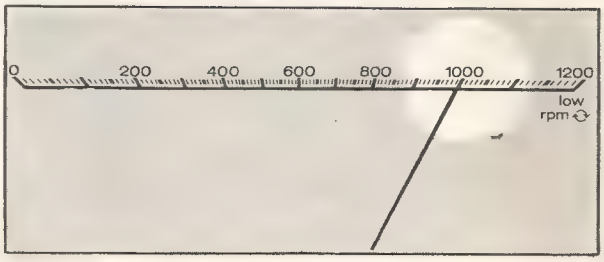
TEST RESULTS

A. An equal drop in rpm on each spark plug indicates satisfactory engine operation.



B. One or more cylinders showing no drop or only a slight drop in rpm can indicate defective plugs, valves, rings or carburetion.

Note: *If rings or valves are suspected a compression test should be made.*



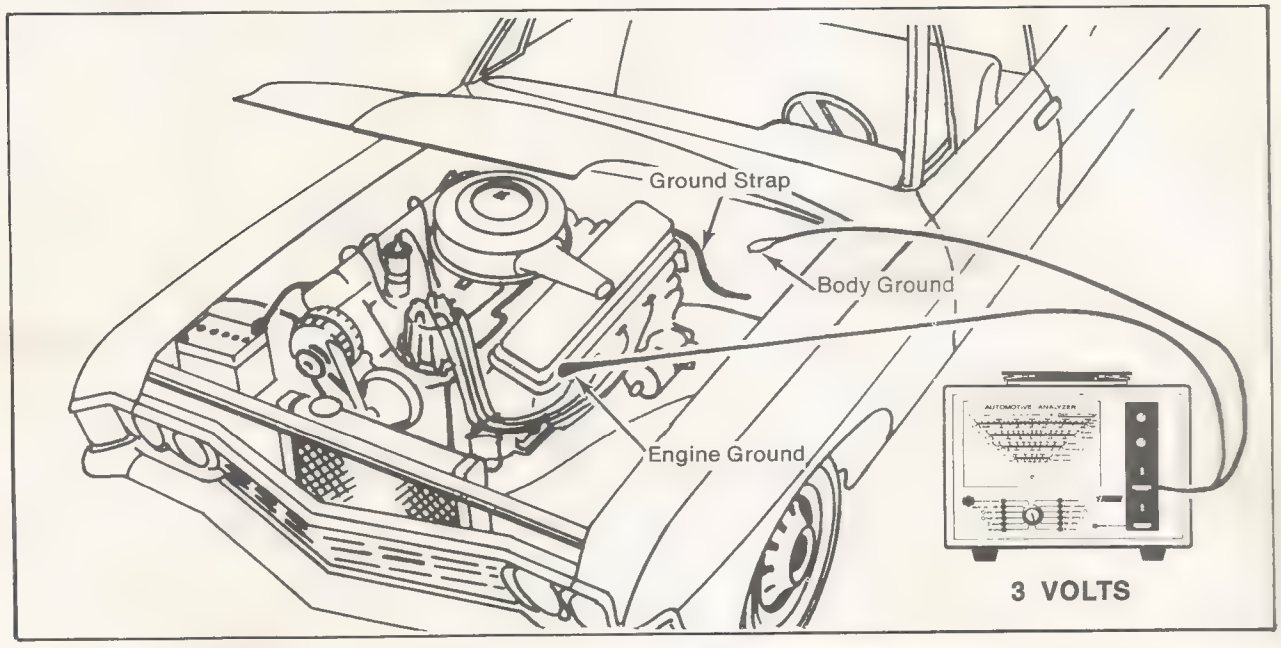
GROUND STRAP TEST

(ENGINE TO BODY)

The ground strap from the vehicle body to the engine provides the return circuit from the lights and other accessories to the battery. A defective ground strap or its connections could cause an inaccurate voltage regulator setting, resulting in higher voltages to the electrical system.

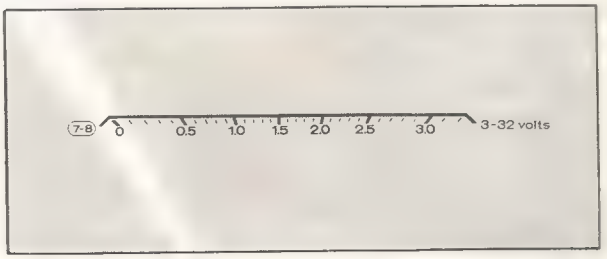
1. Connect one test lead to a good engine ground and the other to a good body ground.
2. Turn Selector switch to the 3 VOLTS position.
3. Start engine and operate at approximately 1200 RPM.
4. Turn on headlights and note voltmeter reading.

Note: *If meter reading is downscale, reverse test lead connections.*

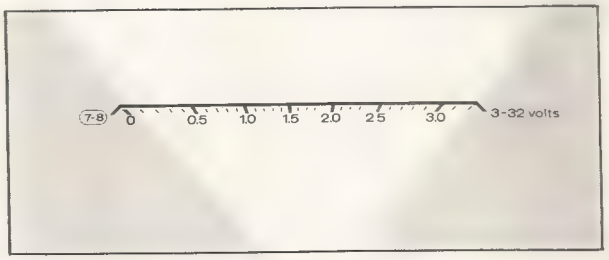


TEST RESULTS

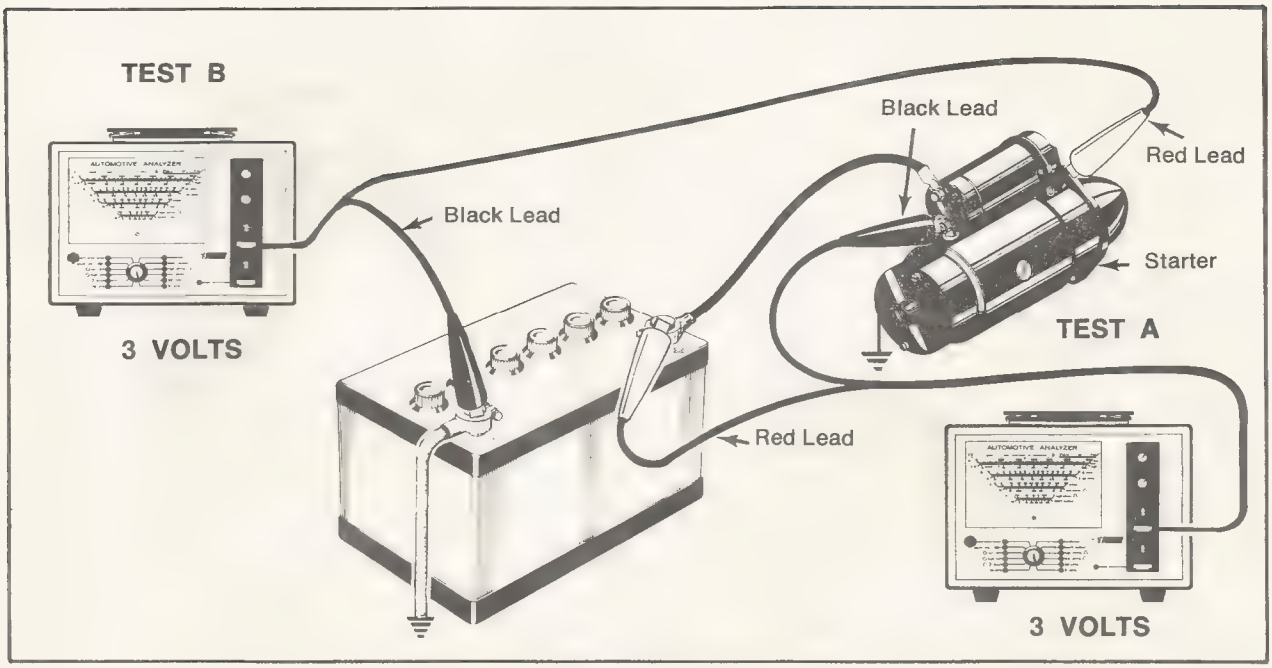
A. A reading less than .1 volt indicates a good ground strap and connections.



B. A reading exceeding .1 volt indicates a defective ground strap or its connections. Clean connections of the ground strap and repeat test before replacing ground strap.



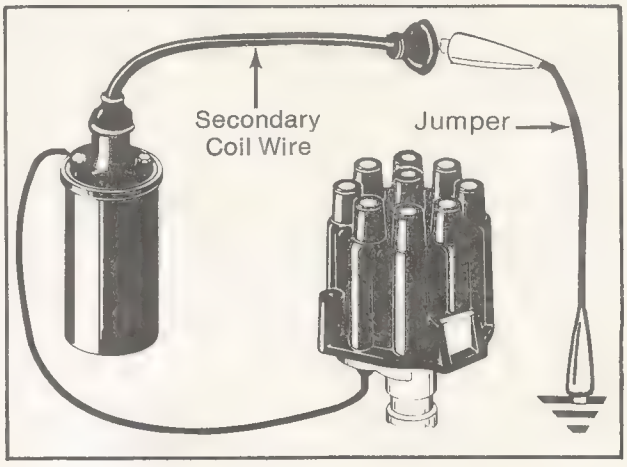
STARTER CIRCUIT VOLTAGE LOSSES



1. Turn Selector switch to 3 VOLTS position.
2. Ground secondary coil wire so that engine will not start.
3. While cranking engine, measure the voltage loss:

   A. From positive battery post (negative on a positive grounded system) to starter terminal on starter.

   B. From negative battery post to starter housing.

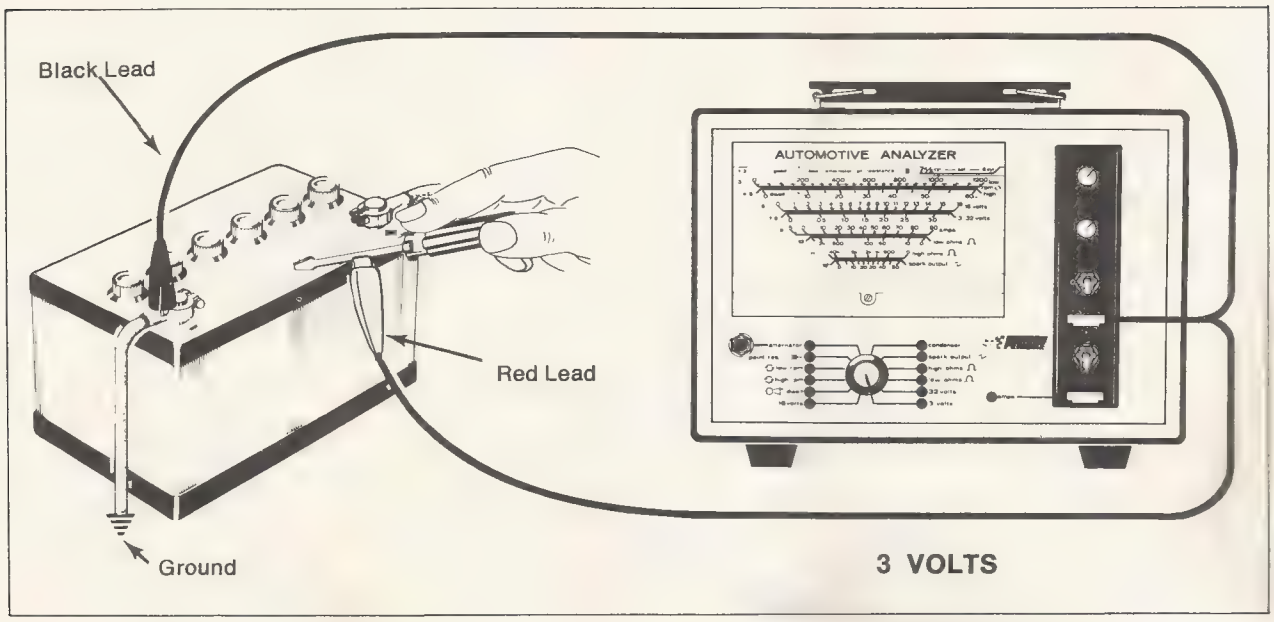


TEST RESULTS

A. A voltage loss of more than .5 volts in a 12 volt system (.3 in a 6 volt system) in **A** above or more than .2 volt in a 12 volt system (.1 in a 6 volt system) in **B** above may seriously effect starter performance.

High voltage losses can be caused by dirty or loose connections, defective cables or cables too small to carry the current.

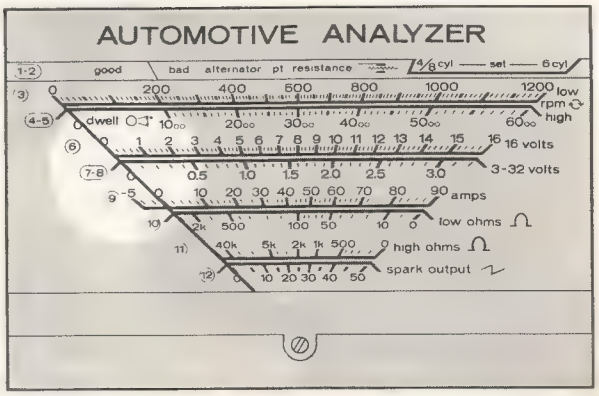
BATTERY: EXTERNAL LEAKAGE



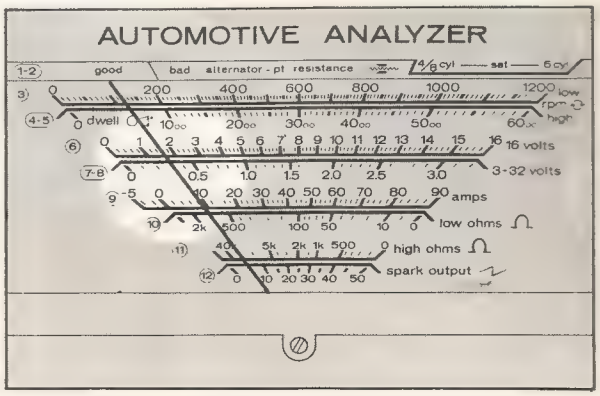
1. Turn Selector switch to the 3 VOLTS position.
2. Connect red or black lead (depending on battery polarity) to the ground post of the battery.
3. Touch other test lead along the top of the cell covers and around the case of the battery. Observe meter for any indication of meter movement.

TEST RESULTS

A. No meter movement indicates a clean battery with no external leakage.



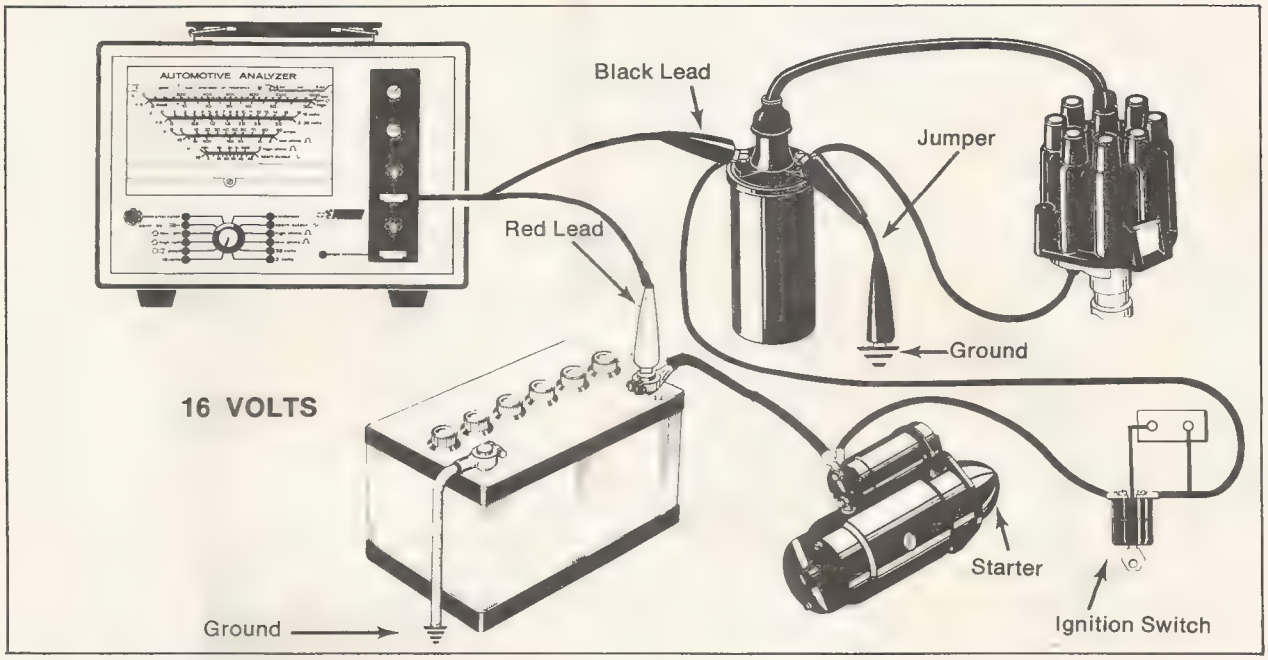
B. Any movement of the meter pointer indicates acid or some conducting material on the battery case. Clean battery and hold down clamps with baking soda and water.



PRIMARY IGNITION SYSTEM TESTS

I. PRIMARY CIRCUIT RESISTANCE

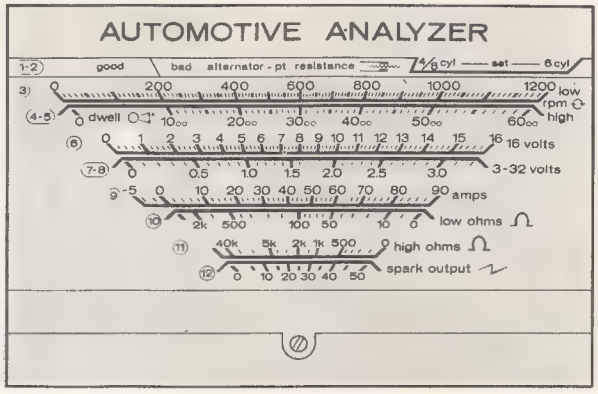
1. Turn Selector switch to the 16 VOLTS position.
2. Connect jumper and test leads as shown.
3. Crank engine and read voltmeter.



TEST RESULTS

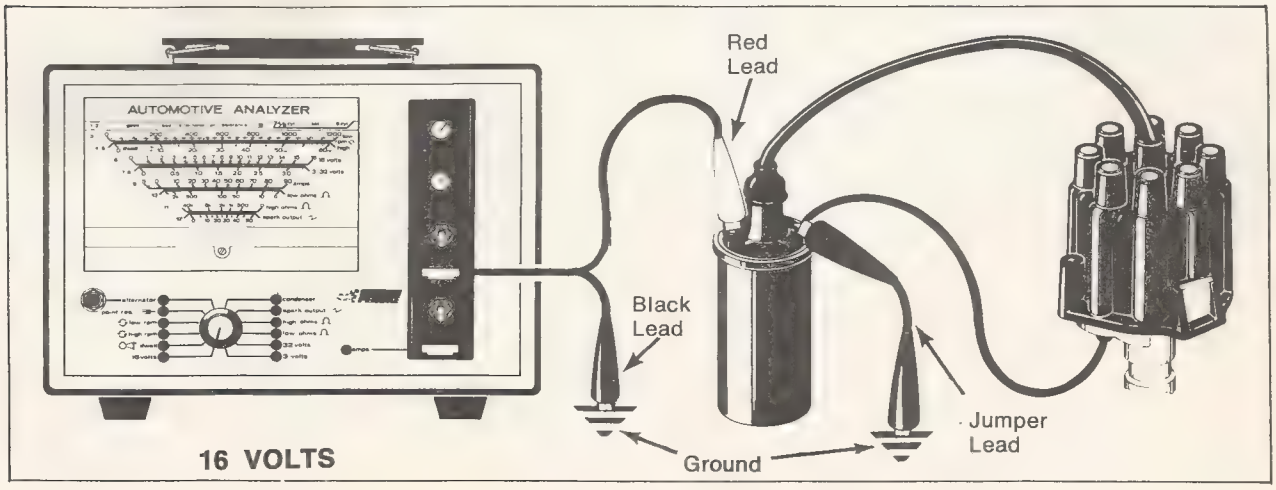
A voltage reading of more than 0.6 volts with engine cranking (0.3 volts on 6 volt systems) indicates high circuit resistance.

NOTE: *Several makes of automobiles manufactured between 1956 and 1963 did not use a ballast resistor by-pass circuit during cranking. On these cars, the voltage read on the meter may be as high as 5 volts.*



II. PRIMARY IGNITION VOLTAGE

1. Turn Selector switch to the 16 VOLTS position.
2. Connect jumper and test leads as shown.
3. Turn the ignition switch "on" and read voltmeter.



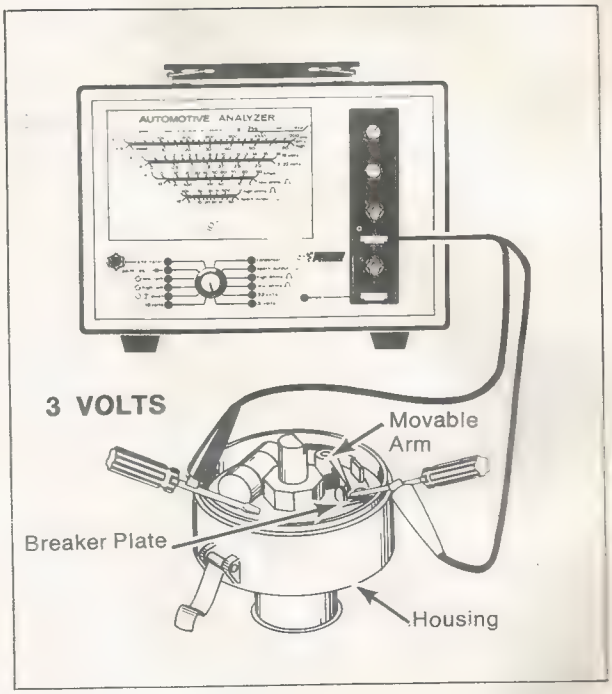
TEST RESULTS

SYSTEM	VOLTMETER SHOULD READ
6 volt	5.5 volts minimum
12 volt (without external resistor)	11.2 volts minimum
12 volt (with external resistor)	4.5 to 7.5 volts

Voltage Zero	**Voltage lower than values given**	**Voltage is 11.2 volts or higher on a 12 volt system with an external resistor**
An open circuit exists between the coil and battery.	Excessive resistance exists between coil and battery.	Resistor by-pass section of ignition switch is defective or resistor has been by-passed.

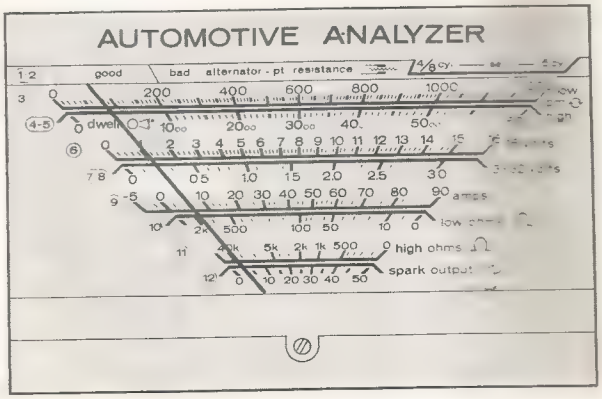
DISTRIBUTOR RESISTANCE TEST

1. Turn Selector switch to 3 VOLTS position.
2. Remove cap from distributor.
3. Crank engine until points are closed.
4. Turn ignition switch "on" and read voltage on meter from:
   - A. The distributor primary terminal of coil to movable arm of breaker points.
   - B. The movable arm of breaker points to breaker plate.
   - C. The breaker plate to distributor housing.
   - D. The distributor housing to engine block.



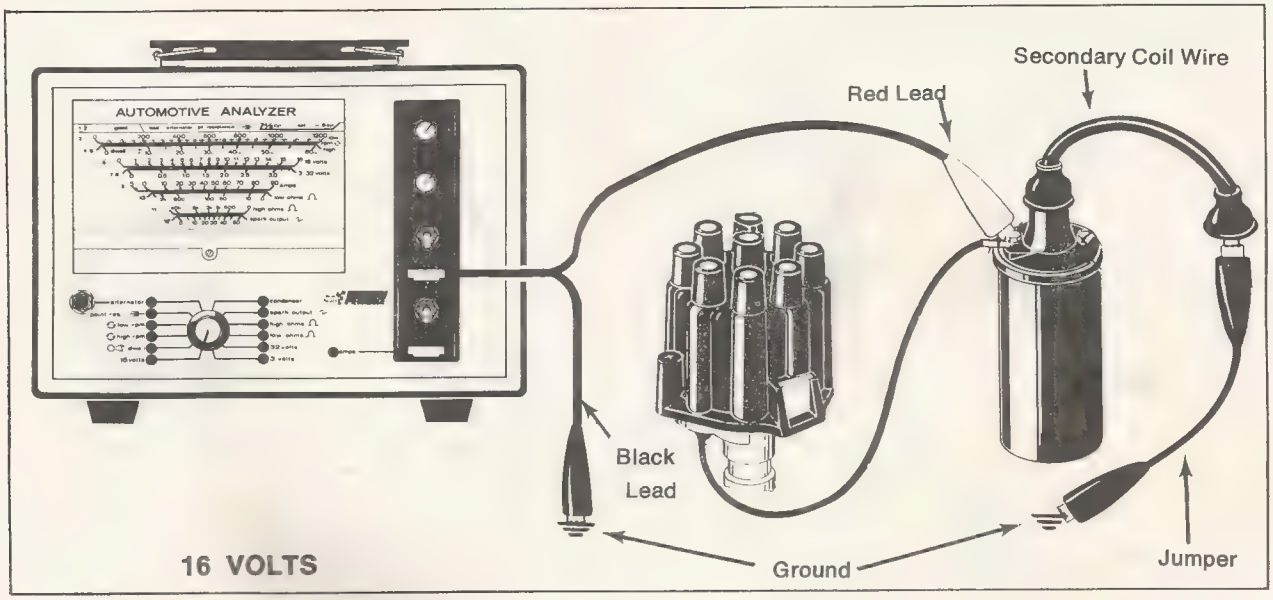
TEST RESULTS

The voltage drop in either A, C, or D should not be higher than 0.05 volts. The voltage drop in B should not be higher than 0.2 volts.



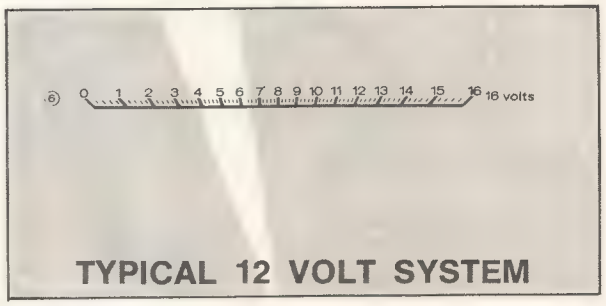
DISTRIBUTOR – SHORTS AND OPENS

1. Turn Selector switch to the 16 VOLTS position.
2. Connect test leads as shown.
3. Ground the secondary coil wire so the engine will not start. Turn the ignition switch "on." With the points open, the meter reading should equal the battery voltage. With the points closed the meter reading should be zero.
4. Crank the engine and observe the meter reading.



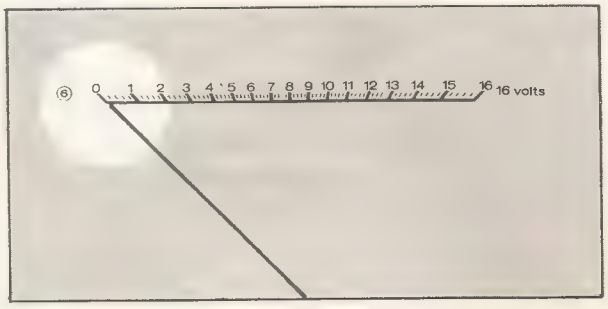
TEST RESULTS

The voltage should be one-third to one-half the battery voltage while cranking the engine.



If voltage is zero while cranking engine:

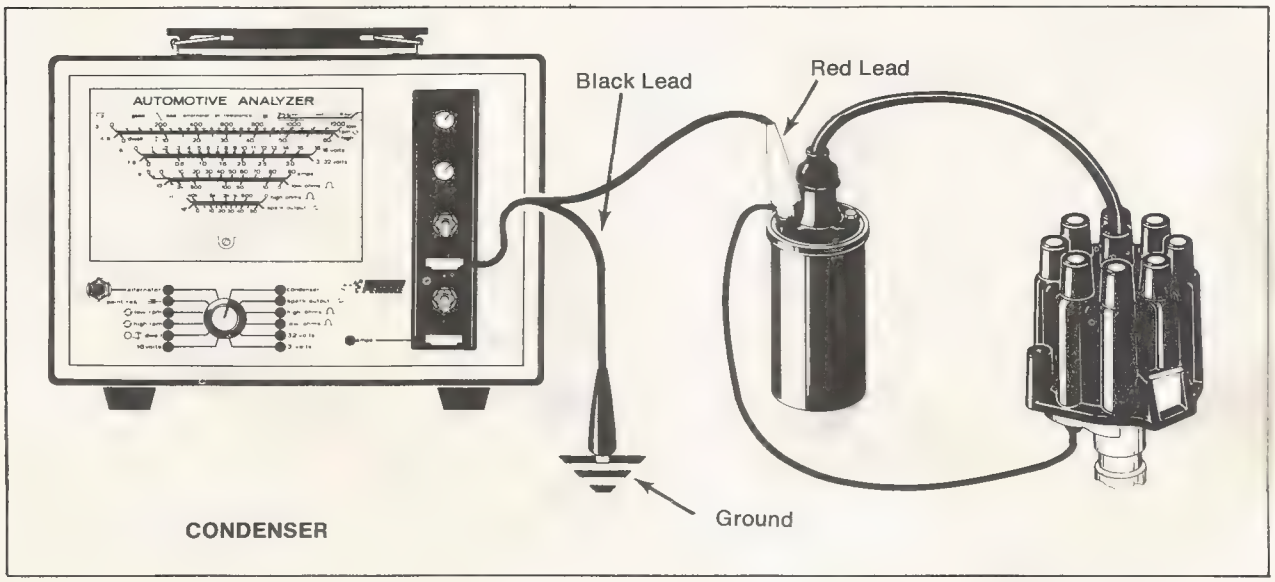
A. Current is not reaching the distributor.
B. The points are not opening.
C. The moveable point, pigtail, or stud, is grounded.
D. The condenser is shorted.



CONDENSER—DISTRIBUTOR

An open or poorly grounded ignition condenser can cause arcing of the points or even prevent the engine from starting. The ANALYZER provides a master condenser that can be used as a substitute for the ignition condenser.

1. Connect test leads as shown.
2. Place Selector switch in the CONDENSER position.
3. Start engine and operate at idle RPM.



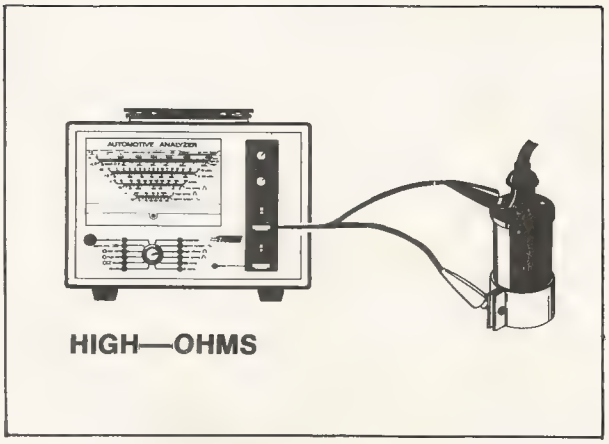
TEST RESULTS

A. If any improvement is noticed in the spark, starting or running of the engine, the distributor ignition condenser is open, the pigtail connection is not clean and tight or the condenser is not well grounded.

Note: *The master condenser can not be substituted for a partially shorted or a dead short condenser. To find this condition, perform the Distributor Shorts and Open test, page 31.*

COIL GROUND

1. Turn Selector switch to the HIGH-OHMS position, and calibrate ANALYZER as shown on page 3.
2. Disconnect both primary wires from the coil. Connect one test clip to a coil screw terminal and the other to the coil case.
3. Read meter.

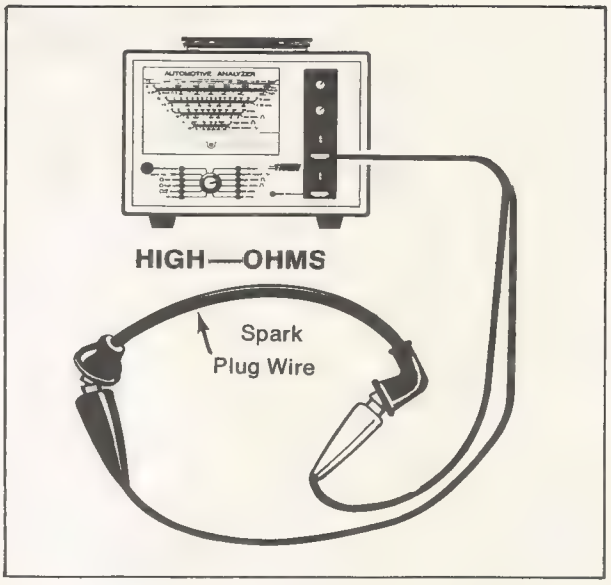


TEST RESULTS

The meter should show no movement. Any movement of the meter pointer indicates a grounded coil winding.

SPARK PLUG WIRE RESISTANCE

1. Turn Selector switch to the HIGH-OHMS position, and calibrate ANALYZER as shown on page 3.
2. Remove spark plug wires for testing, one at a time.
3. Using the red and black leads, connect one lead to each end terminal of spark plug wire.



TEST RESULTS

A. The actual resistance reading will vary widely depending on type of spark plug wire and length.

B. No resistance reading (no pointer movement) indicates a defective wire (open wire).

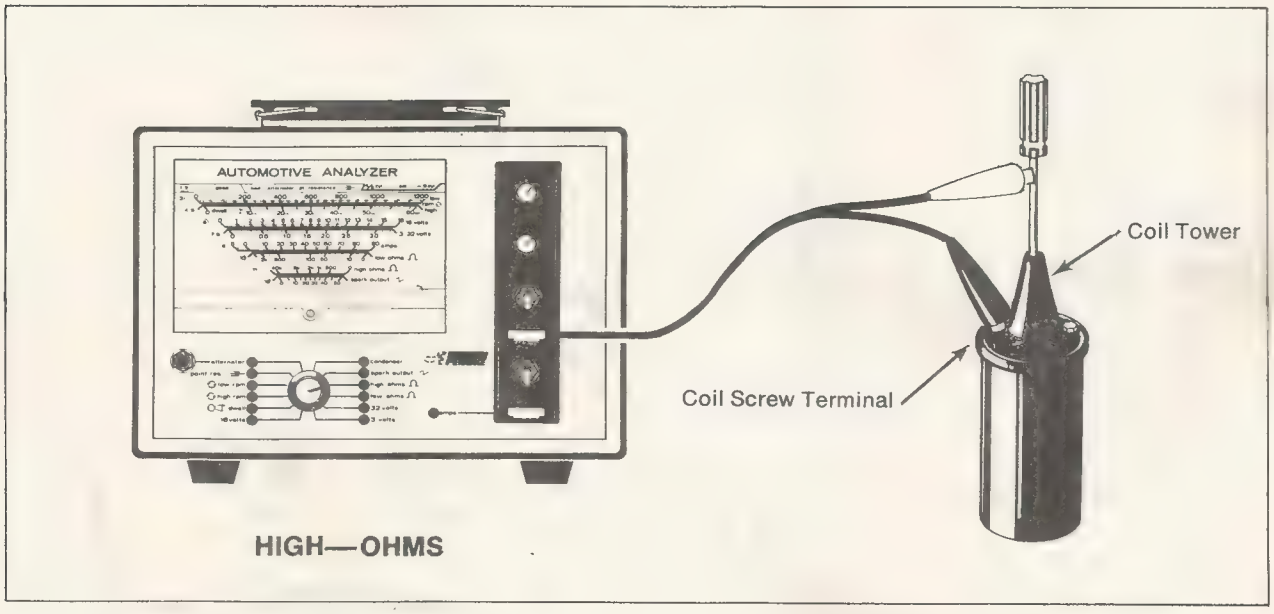
TYPICAL RESISTANCE WIRE VALUES

WIRE TYPE	ACCEPTABLE VARIATION ohms per foot
TVRS-LR*—4000 ohms per foot	3000-7000
TVRS-HR*—8000 ohms per foot	5000-12000

*or Radio Resistance

COIL SECONDARY RESISTANCE

1. Turn Selector switch to the HIGH-OHMS position, and calibrate ANALYZER as shown on page 3.
2. Remove secondary coil wire from the coil tower.
3. Connect one test lead to either coil screw terminal. Connect the other lead to a small screwdriver or prod and insert in the coil tower as shown.
4. Read meter and compare with manufacturer's specification.



TEST RESULTS

The resistance of most coils for standard ignition systems are given in the following table.

MANUFACTURER	SECONDARY RESISTANCE
American Motors	6.5K-9.5K
Chrysler	9.5K-11.5K
Ford	7.5K-9.0K
Delco Remy	5.5K-9.5K

HORNS

1. Turn Selector switch to the 16 VOLTS position.

2. Connect black test lead to ground and the red test lead to the "H" terminal of the horn relay.

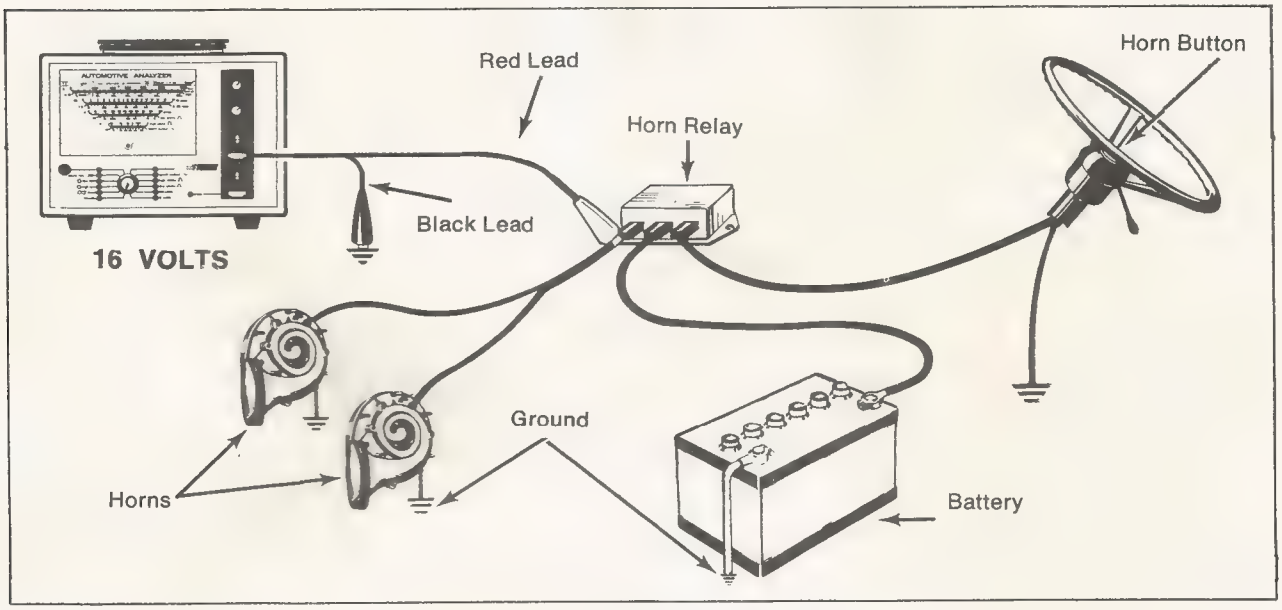
3. Operate the horn ring or button and read 16 volt scale of meter.

TEST RESULTS

A. ZERO READING— Defective horn relay, horn button or a break in wiring between the horn button and relay.

B. BATTERY VOLTAGE READING— Break in the wiring in the horn, between relay and horn or the horn is not grounded.

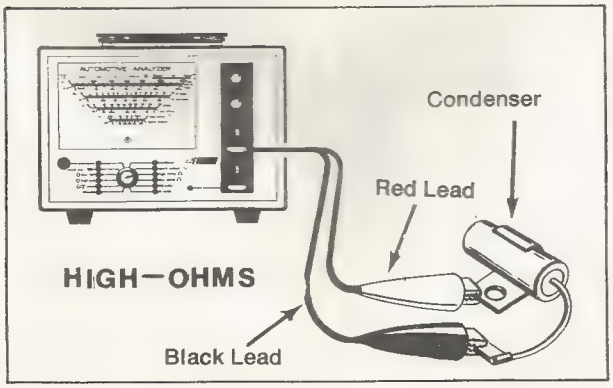
C. READING LESS THAN 10 VOLTS (12 VOLT SYSTEM) — Shorted horn, poor wiring or relay points not making good contact.



CONDENSERS

1. Turn Selector switch to the HIGH-OHMS position. Calibrate as shown on page 3.

2. Disconnect one condenser wire—generally, the metal case is the other connection. Connect the test leads as shown.



TEST RESULTS

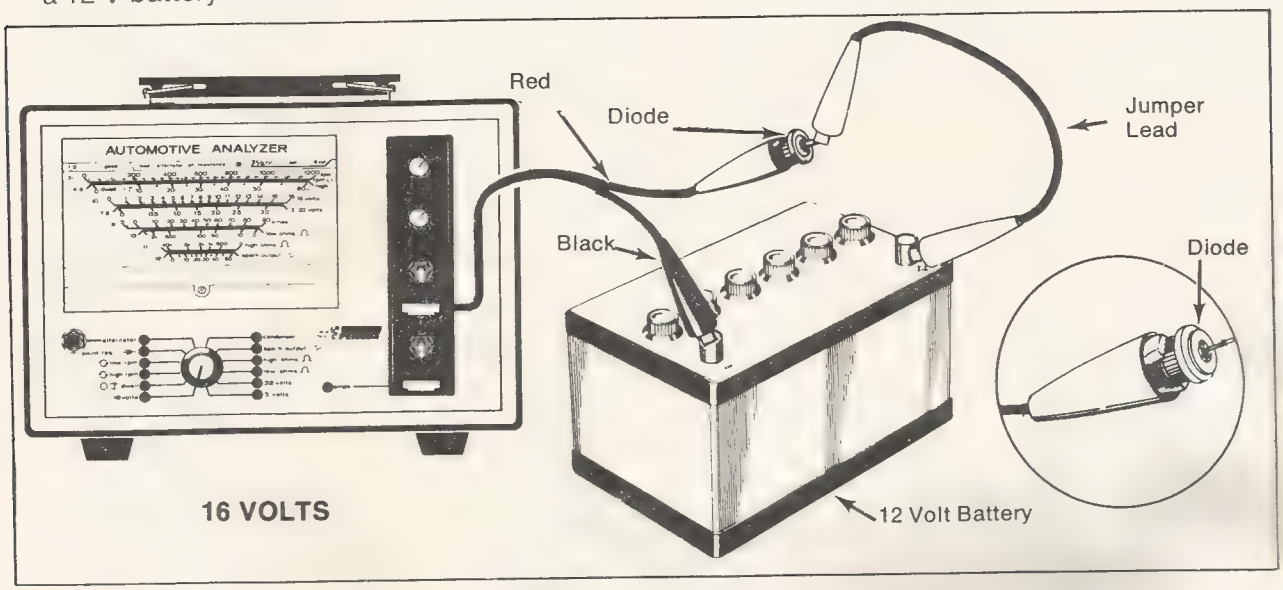
A. CONDENSER O.K.—Meter will deflect **very slightly** to the right and return to the left edge of meter scale as connection is made. Reverse leads and repeat test to confirm slight movement.

B. CONDENSER OPEN—No deflection at all. Meter stays at left edge of meter scale.

C. CONDENSER SHORTED OR LEAKY—Meter will read to the right of the 40K mark on meter scale.

DIODES—ON THE BENCH TEST

1. Turn Selector switch to 16 VOLTS position.
2. Using a jumper lead, connect the diode to a 12 V battery as shown.
3. Take two readings (turn diode end for end for the second reading).



TEST RESULTS

Good Diode	Shorted Diode	Open Diode	Leaky (Partially Shorted Diode)
One reading of zero and one reading of battery voltage.	Both readings of full battery voltage.	Both reading of zero.	One reading of battery voltage and the other above zero.

FUSES

This test can be performed on any fused automotive circuit.

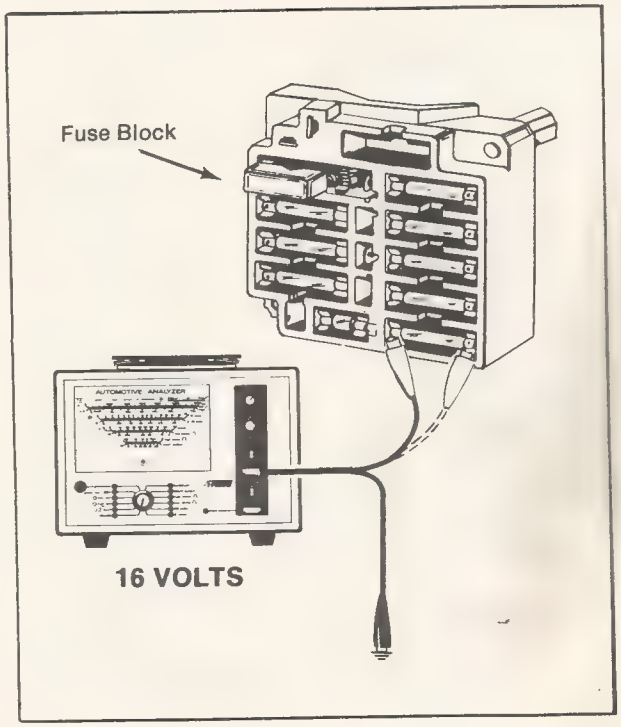
1. Turn Selector switch to the voltmeter range that corresponds to engine's battery voltage.
2. Turn engine ignition switch and/or the switch for the accessory "on".
3. Ground black voltmeter lead (red for positive ground).
4. Touch both sides of the fuse in turn with red voltmeter lead.

TEST RESULTS

A. Battery voltage on both sides of fuse —Fuse is good.

B. Battery voltage on one side of fuse and zero on the other side—Fuse is open.

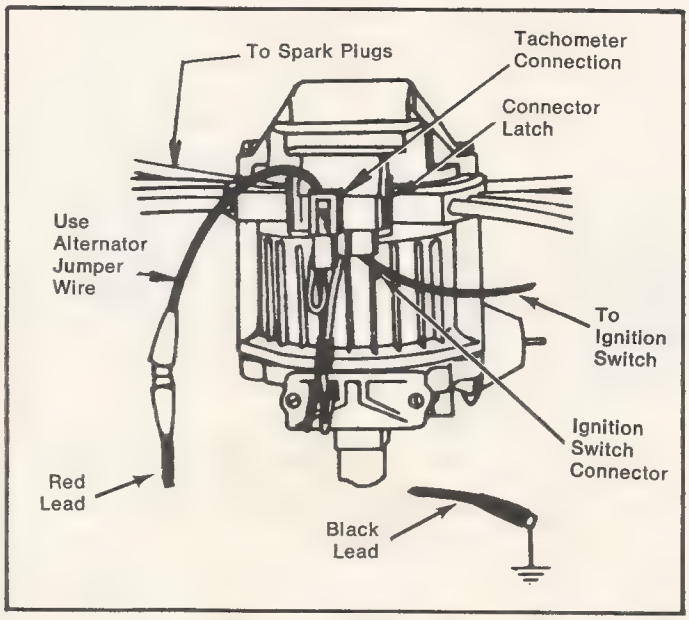
C. Zero voltage on both sides of fuse—Open circuit between battery and fuse.

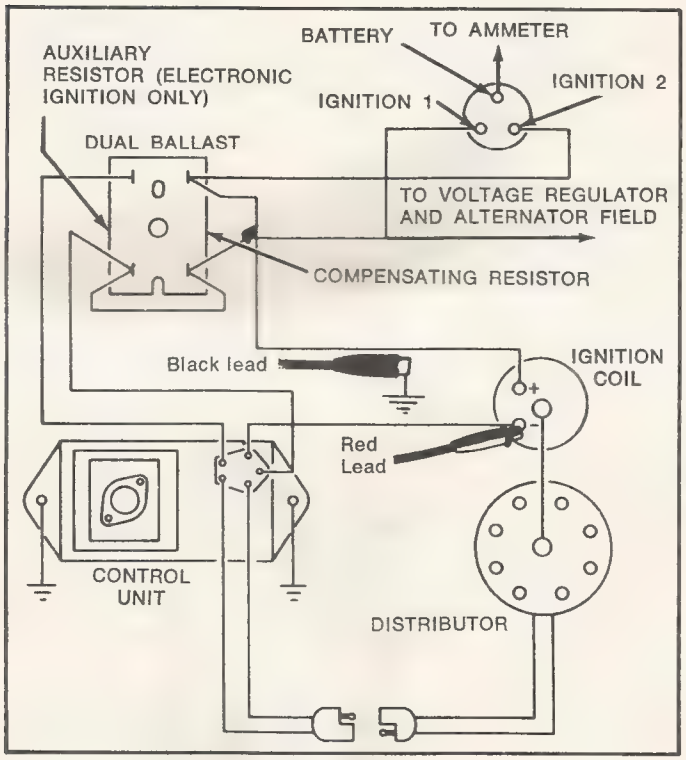


RPM CONNECTIONS – NONSTANDARD IGNITION SYSTEMS

DELCO UNITIZED IGNITION
(Magnetic Pulse)

This transistorized ignition system has the ignition coil mounted directly onto the distributor cap. Provision has been made for a tachometer connection as shown. Connect Red lead to tachometer connection and Black lead to a good ground.





CHRYSLER IGNITION
(Magnetic Pulse)

This transistorized ignition system can be identified by the double primary wire leading to the distributor, a dual ballast resistor, and a control unit. Tachometer readings are obtained by connecting the Red lead to the negative terminal of the ignition coil and the Black lead to a good ground as shown.

MAGNETO

The instrument can be used on most magneto systems where a connection can be made to the breaker points. On some engines, the hot lead is brought out to the primary shorting switch used to stop the engine. (Not the grounding strap to the spark plug.)

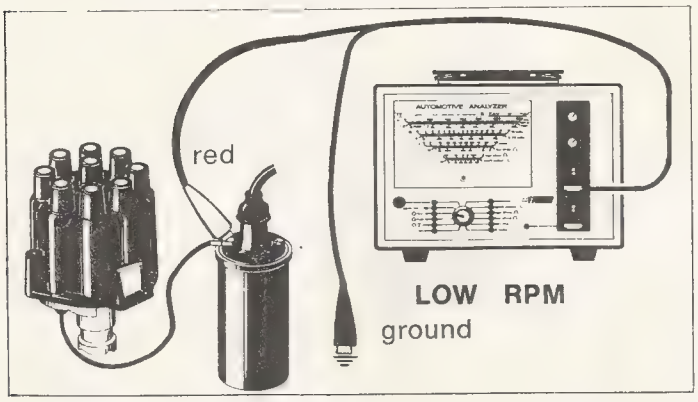
CAPACTIVE DISCHARGE

Some capacitive discharge systems are provided with a lug to which a tachometer can be connected. On other systems, the tachometer can usually be connected from ground to the primary wire leading to the breaker points, or in some cases, from ground to the coil primary.

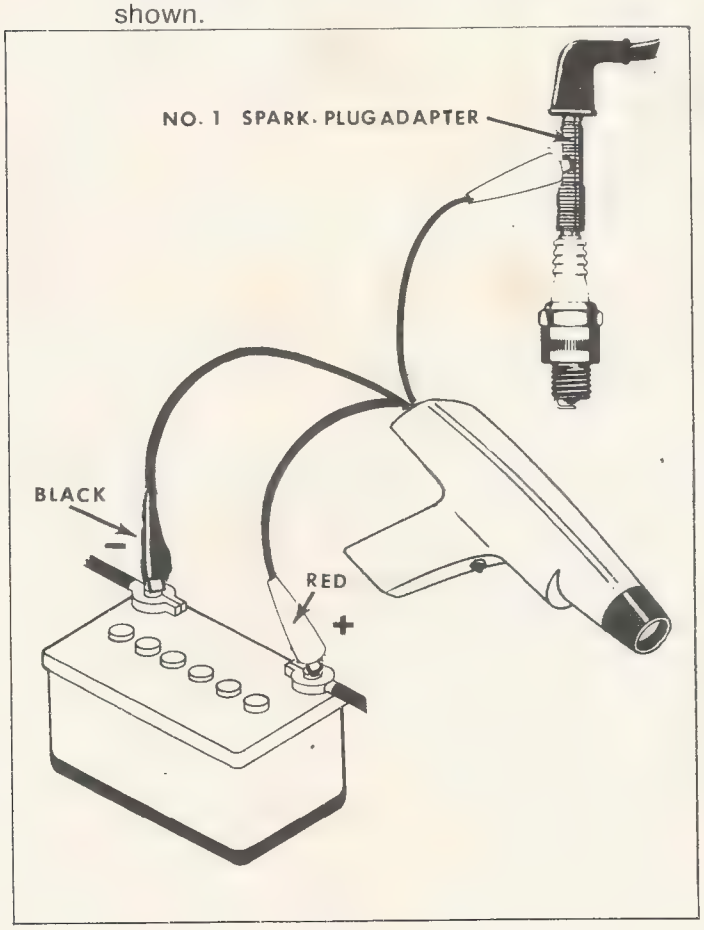
TIMING LIGHT TESTS

I. INITIAL TIMING

1. Calibrate ANALYZER in the LOW RPM position, page 3, and connect test leads as shown.

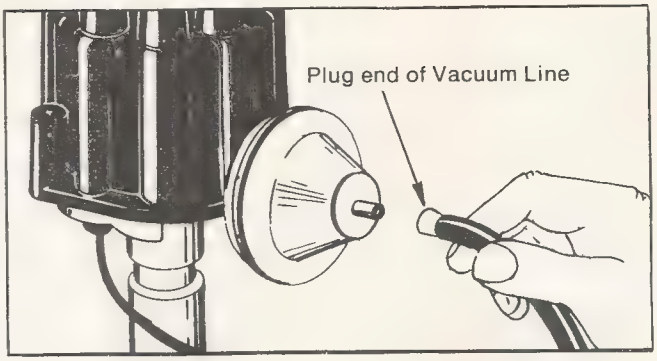


2. Connect timing light leads to the proper power source (12V battery or 110 Volts, A.C.) and the #1 spark plug as shown.

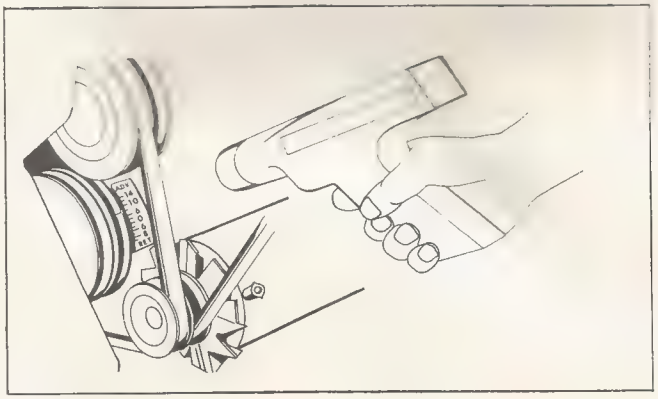


3. Start engine and operate at idle RPM.

4. Disconnect and plug vacuum advance line to the distributor.

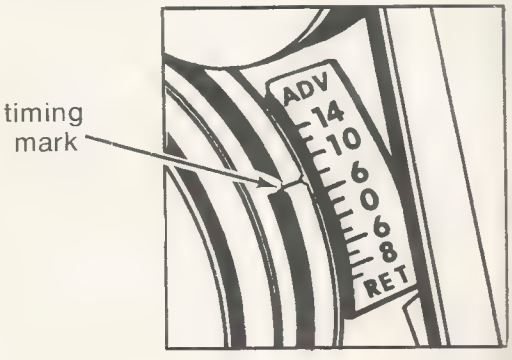


5. Press switch on timing light and observe timing mark.



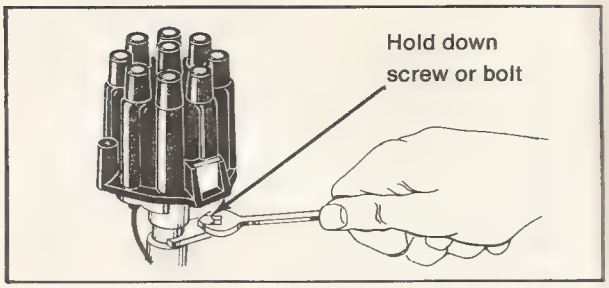
TEST RESULTS

Position of mark in relation to the timing indicator must agree with manufacturer's specifications.

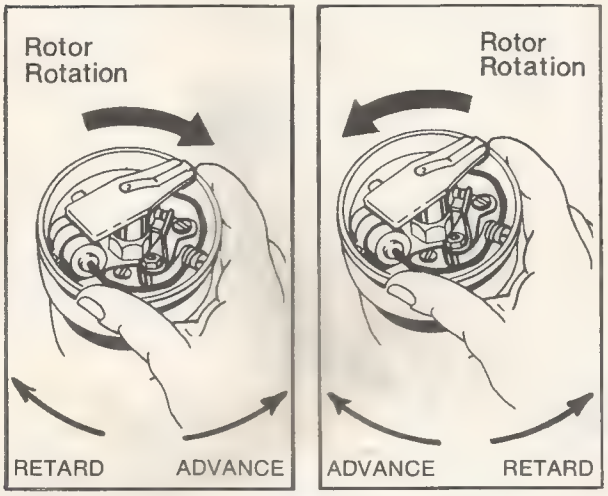


II. TIMING ADJUSTMENT

1. To change the timing of the engine, loosen distributor hold down screw or bolt.



2. Rotate the distributor body in the direction required to align mark.



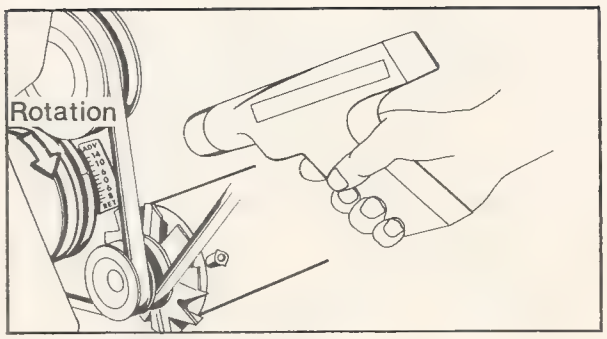
3. Tighten distributor locking screw and recheck timing.

III CENTRIFUGAL ADVANCE CHECK

1. With vacuum advance line disconnected and engine at idle RPM, note position of timing mark.
2. Increase engine speed gradually while observing the timing mark.

TEST RESULTS

The timing mark should move steadily and without jerking, opposite to the direction of rotation, as the engine speed is increased to about 1800 RPM (HIGH RPM range). Then, the timing mark should move back smoothly as the speed is decreased. If the timing mark does not start to move within 50 RPM of the specified speed or move according to specification, the distributor must be cleaned or repaired.



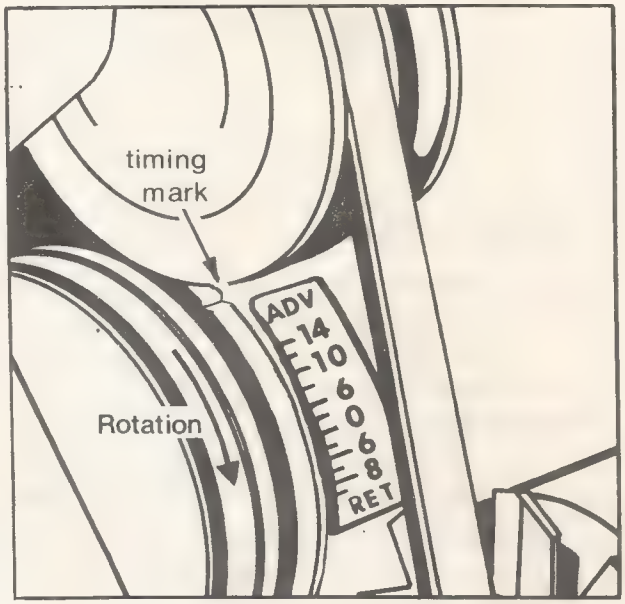
IV VACUUM ADVANCE CHECK

1. Operate engine at approximately 1500 RPM.
2. Reconnect vacuum advance line to distributor and observe timing change.

Note: *On vehicles equipped with certain emission control systems, there will be no vacuum advance when performing this test. Check manufacturer's test procedure.*

TEST RESULTS

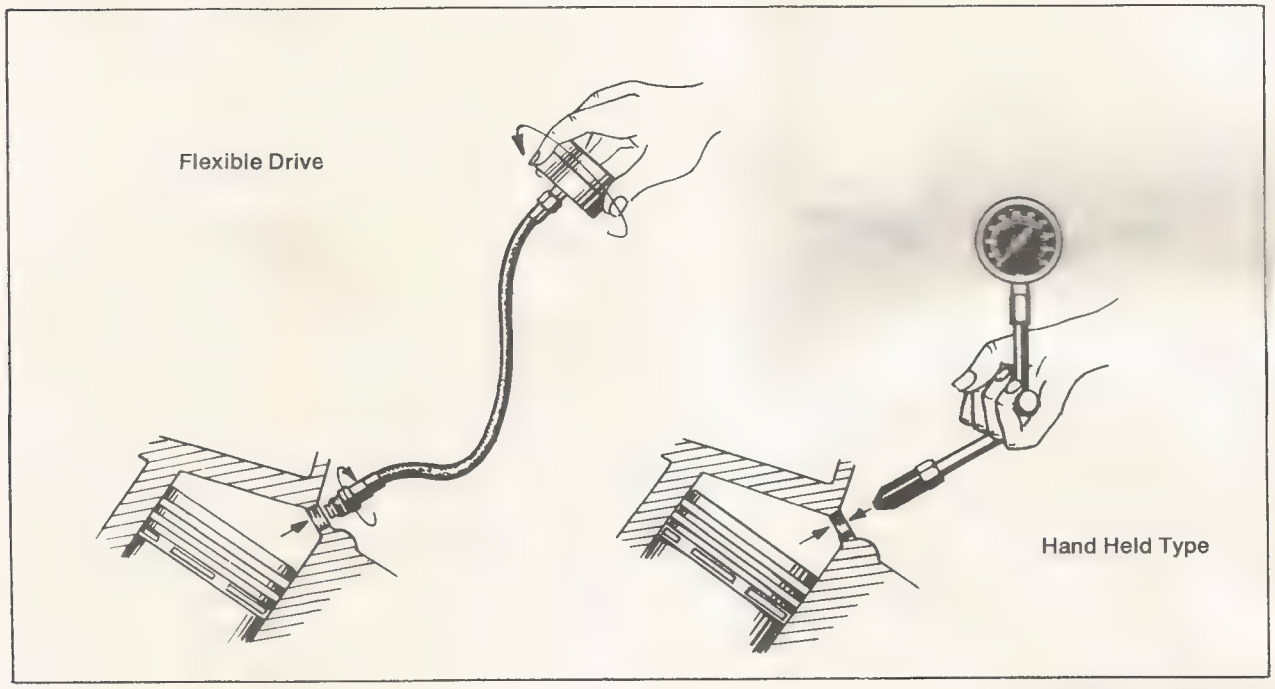
The timing mark should move opposite to direction of engine rotation to advance the spark, and the timing mark will appear beyond the range of the indicator.



COMPRESSION

1. With engine stopped and at normal operating temperature, loosen all spark plugs about one turn.
2. Use an air hose or tire pump to blow the dirt out of the spark plug wells.
3. Remove all spark plugs and spark plug gaskets.
4. Set the carburetor throttle valve wide open, and ground the secondary coil wire.
5. Screw or hold (depending on type) the compression gauge to the spark plug hole.
6. Crank engine for at least four compression strokes. Note and record the reading on first full stroke as well as on final stroke.

   Note: *Repeat the above step on all cylinders.*



TEST RESULTS

A. NORMAL—Compression builds up evenly to specified reading and varies less than 10-15 pounds between cylinders (highest to lowest).

B. RING PROBLEMS— Compression low on first stroke, builds up on successive strokes, but not to specification.

C. VALVE PROBLEMS— Low compression on first stroke and does not build up much on successive strokes.

Note: *To differentiate between valves and rings, pour a teaspoon of S.A.E. # 30 oil into each cylinder and retest:*

a. A small or no increase in compression indicates bad valves.

b. A considerable increase (10 or more pounds) in compression indicates poorly seated or worn piston rings.

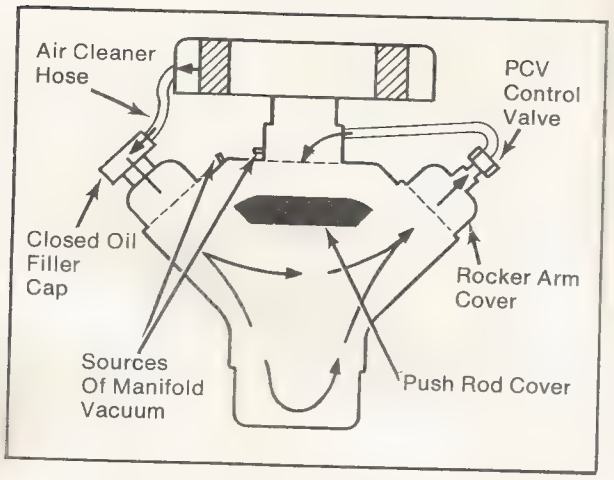
D. LEAKING HEAD GASKET — Results are the same as Valve Problems on two adjacent cylinders. Problem is usually accompanied by indications of water and/or oil in cylinder.

E. CARBON DEPOSITS— Readings are considerably higher than specifications due to accumulation of carbon between piston top and cylinder head. Using a spark plug with higher heat range sometimes corrects this fault.

VACUUM GAUGE TESTING

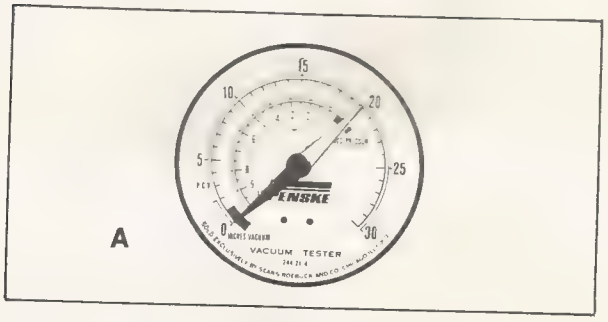
I ENGINE CONDITION TESTS

1. Connect the vacuum gauge to a source of intake manifold vacuum.

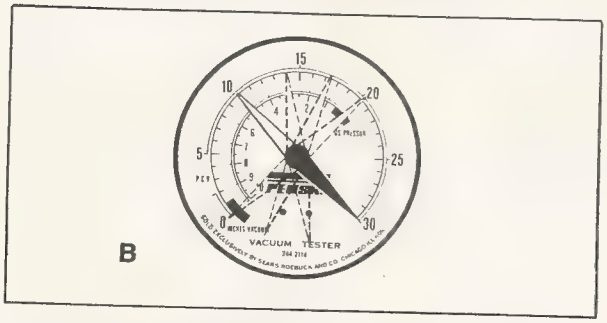


2. Operate the engine at normal temperature and idle speed.
3. Note vacuum gauge reading.

TEST RESULTS



A. Figure **(A)**-A steady reading of between 15 and 22 indicates a mechanically sound engine.

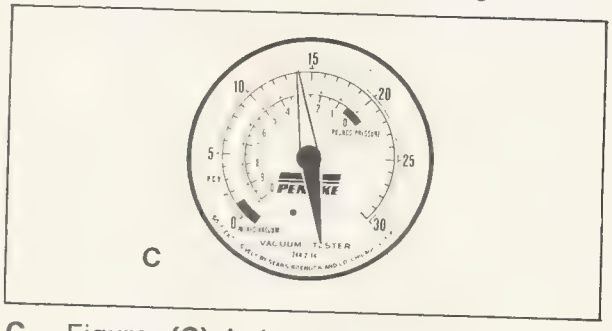


B. Figure **(B)**-A pointer which sweeps or wanders erratically through several inches indicates a malfunction affecting all cylinders unequally and not consistently. To help isolate the trouble area, run the engine at about 2000 RPM. If the pointer steadies, check:

Ignition and timing
Centrifugal advance, (loose springs at idle).

If the sweeps become shorter and more rapid, check for:

Intake system leaks
Sticky valves
Weak or broken valve springs



C. Figure **(C)**-A low, but steady reading indicates a loss of power affecting all cylinders alike. Check for:

Late Timing
Intake system leaks
Warped intake manifold
Leaky carburetor flange gasket

II PCV SYSTEM TEST

1. Operate the engine at normal temperature and idle speeds.
2. Remove the air cleaner hose from the rocker arm cover or closed oil filler cap.
3. Hold the vacuum gauge rubber hose fitting firmly over the engine opening. Note gauge reading.

TEST RESULTS

A. A properly working PCV System will draw a vacuum of about 3 to 5 inches within 10 seconds.

B. If there is very little change in gauge reading, the PCV valve is clogged or there are excessive air leaks into the crankcase, and the engine may not be properly ventilated.

III EXHAUST RESTRICTION TEST

1. With vacuum gauge connected to a source of manifold vacuum, increase engine speed to 2000 RPM, maintain this speed, and note the vacuum gauge reading.

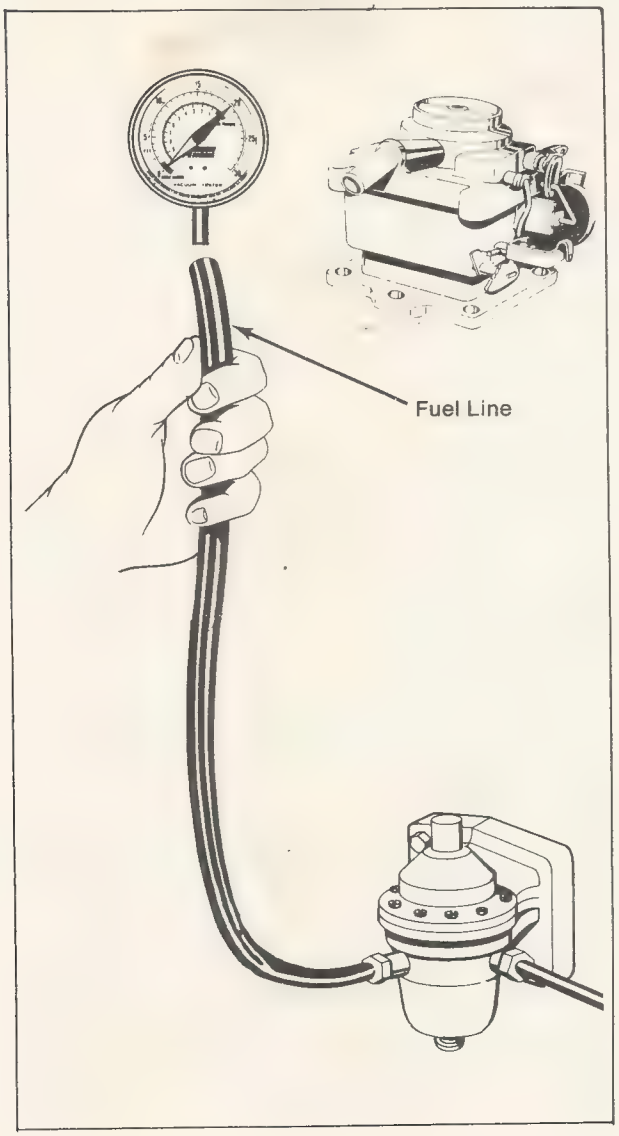
TEST RESULTS

A gradually decreasing vacuum may indicate a restricted exhaust system.

FUEL PUMP TESTING

I PRESSURE TEST

1. Disconnect the fuel line at the carburetor and attach the vacuum guage hose to the fuel line.



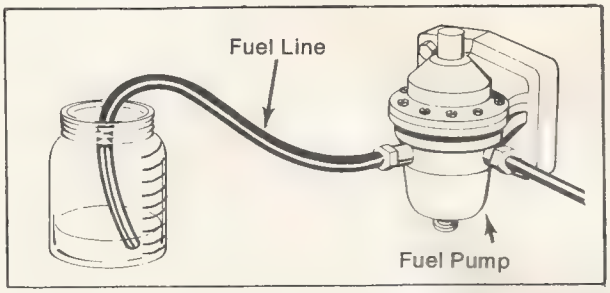
2. Operate engine at idle. Hold gauge at carburetor height and note gauge reading.
3. Reconnect fuel line to carburetor.

TEST RESULTS

Gauge reading must compare with manufacturer's specifications. If specifications are not immediately available, fuel pump pressure can be considered satisfactory if it is between 4 and 6 PSI with lower readings for smaller displacement engines. If pressure reading falls outside this range, it is imperative to consult the manufacturer's specifications before condemning the fuel pump.

II VOLUME TEST

1. Operate engine, fuel line connected, to fill the carbuertor fuel bowl. Stop engine.
2. Disconnect fuel line at carburetor. Connect a flexible hose to fuel line. Lead other end of hose to a container marked in fluid ounces.



3. Operate the engine and collect the discharge from the fuel pump for 30 seconds. Stop engine and reconnect fuel line.

   CAUTION: Care must be exercised to avoid spilling of the fuel or the starting of a fire.

TEST RESULTS

Consult manufacturer's specifications for exact delivery rate. Otherwise, be guided by the following table.

Engine displacement in Cubic inches	Ounces collected in 30 Seconds
Up to 225	8
225 to 350	11
Over 350	16

TUNE UP TIPS

ENGINE STARTS HARD OR WILL NOT START

1. Improper carburetion due to:

A. Choke not operating properly.

B. Cylinders and manifold flooded with gasoline.

C. Carburetor passages restricted.

D. Insufficient quantity or lack of gasoline in carburetor.
   1. Partially clogged fuel filter.
   2. Clogged or restricted fuel lines from gas tank to carburetor.
   3. Leaking carburetor gaskets.
   4. Low carburetor fuel level.

E. Defective fuel pump.

F. Air leaks at intake manifold or carburetor due to:
   1. Loose manifold nuts or cap screws.
   2. Leaking intake manifold or carburetor gaskets.
   3. Leaks occurring in vacuum line connections at intake manifold.
   4. Leaks occurring from vacuum operated accessories.
   5. Warped carburetor or manifold attaching flanges.
   6. Cracked intake manifold.

G. Poor grade or old fuel combined with cold weather.

H. Vent in fuel tank filler cap clogged or restricted.

2. Electrical difficulties.

A. Battery
   1. Low or completely discharged.
   2. Terminals loose or badly corroded.
   3. Improper ground.
   4. Cables frayed or undersize.
   5. Battery capacity too small for the job.
   6. Charging circuit not operating satisfactorily.

B. Ignition
   1. Primary circuit.
      a. Broken wire lead between coil and distributor.
      b. High circuit resistance due to corroded, dirty, or loose connections.
      c. Ignition out of time.
      d. Weak or grounded condenser.
      e. Distributor breaker points improperly spaced, dirty, or loose.
      f. Breaker arm sticking, spring weak or broken, or arm grounded.
      g. Loose or grounded distributor terminal post.
      h. Open ballast resistor (12 volt system).
      i. Defective ignition coil.
   2. Secondary circuit
      a. High resistance or open T.V.R. cables.
      b. Corroded secondary cable terminals.
      c. Chafed or cracked insulation on cables.
      d. Ignition coil weak, or inoperative.
      e. Moisture on ignition coil, terminals, distributor cover, spark plug porcelains, or in distributor.
      f. Cracked distributor cap.
      g. Improper installation of secondary cables (not correct for engine firing order).
      h. Spark plugs damaged, dirty, wet, porcelains cracked, or gap improperly spaced.
      i. Rotor contact spring bent or broken.
      j. Distributor rotor damaged or grounded.
      k. Distributor cap center terminal (inner) broken or missing.
   3. Ignition switch.
      a. Loose contacts.
      b. Corroded or burned contacts.
      c. No by-pass circuit.

C. Starter motor.
   1. Inoperative or not operating properly.
   2. Congealed engine oil due to the use of too heavy oil or the formation of sludge.
   3. Water in cylinders causing hydrostatic lock.
   4. Starter motor pinion stuck in flywheel gear.
   5. Clutch slipping in drive pinion.
   6. Starter switch not operating properly.

7. Faulty neutral safety switch on cars with automatic transmissions.
8. Defective starter solenoid.

3. Poor engine compression resulting from:
   A. Loose cylinder head cap screws.
   B. Spark plugs loose in head.
   C. Improperly installed or damaged cylinder head gasket.
   D. Poorly seating valves.
   E. Weak or broken valve springs.
   F. Valves holding open due to insufficient valve clearance.
   G. Valves holding open due to stem being warped, corroded, or gummed.
   H. Badly worn, broken, weak, or stuck piston rings.
   I. Hole in piston.
   J. Scored cylinder walls.
4. Unusual causes.
   A. Valves improperly timed.
   B. Camshaft timing gear broken or timing chain jumped.
   C. Cracked cylinder block.
   D. Excessive internal friction of engine assembly.

SPARK PLUG PROBLEMS

1. Plug does not fire or spark is weak.
   A. Porcelain cracked.
   B. Internal porcelain carbonized or burned.
   C. Moisture or dirt accumulation on external porcelain.
   D. Electrode gap not properly spaced.
   E. Weak ignition coil.
   F. Defective spark cables.
2. Electrodes and porcelain burn at low milages.
   A. Plug heat range too high.
   B. Use of certain type of gasoline having detrimental effect on porcelain.
   C. Excessively lean carburetor mixture.
   D. High cylinder combustion temperature.
   E. Advanced ignition timing.
3. Fouled plugs.
   A. Plugs heat range too cold.
   B. Excessively rich carburetor mixture.
   C. Engine oil passing piston rings.
4. Use of some types of spark plugs and coil suppressors in radio installations.
5. Incorrect polarity of voltage at spark plug.

ENGINE MISFIRES WHEN IDLING—NORMAL ENGINE TEMPERATURES

1. Improper carburetion resulting from:
   A. Float level too high.
   B. Float level too low.
   C. Incorrect or loose jets.
   E. Restricted or partially clogged idle air passage or jet.
   E. Choke system not operating properly.
   F. Air leak occuring between upper and lower carburetor body idle tube.
   G. Air leak occuring around the carburetor throttle shaft.
   H. Idle mixture not adjusted properly.
2. Air leaks in intake manifold or carburetor resulting from:
   A. Loose manifold connections or leaks occuring in vacuum lines and vacuum operated accessories.
   B. Loose manifold nuts or cap screws.
   C. Broken or damaged intake manifold or carburetor gaskets.
   D. Crack in manifold.
   E. Warped or damaged manifold contacting surface.
3. Incorrect ignition timing.
4. Weak ignition coil.
5. Spark plug malfunction.
6. Ignition wires open or leaking to ground.
7. Uneven compression.
8. Unusual causes.
   A. Slight water leaks occurring in the cylinder or combustion chamber.
   B. Air leaks occurring around the intake

valve stem because of excessive valve stem-to-guide clearance.

9. Low battery voltage.
10. Defective PCV system.
11. Defective ignition condenser.
12. Spark advanced too far.
13. Defective ignition switch.
14. Defective valves.

LACK OF POWER OR HIGH SPEED PERFORMANCE.

1. Insufficient or unequal engine cylinder compression.
2. Improper ignition timing.
3. Inoperative manifold heater valve (valve held in closed position).
4. Improper carburetion.
5. Restricted carburetor air inlet resulting from:
   A. Dirty carburetor air cleaner.
   B. Choke valve not completely opening.
6. Throttle linkage not properly adjusted and carburetor throttle valve not completely opening.
7. Carburetor accelerating pump not functioning properly.
8. Improper fuel pump operation.
9. Partially restricted or clogged exhaust pipe, muffler, or tail pipe.
10. Excessive engine temperatures.
11. Preignition.
12. Excessive engine friction resulting from:
   A. Inadequate internal clearances (bearings and pistons).
   B. Use of extreme pressure piston rings.
13. Clutch slippage.
14. Excessive rolling resistance resulting from:
   A. Dragging brakes.
   B. Tight wheel, pinion, differential, or transmission bearings.
   C. Misalignment in power transmitting units.
   D. Misalignment of rear axle.
   E. Underinflated tires.
15. Incorrect rear axle gear ratio or oversize tires.
16. Incorrect valve timing.
17. Worn lobes on cam shaft.
18. Inaccurate speedometer (gives impression of lack of performance).
19. Defective spark plugs.
20. Defective ignition points.
21. Faulty ignition coil.

SPARK KNOCK (DETONATION)

Spark knock (detonation) causes a metallic ringing sound, often described as a "ping" and is usually encountered when the engine is laboring, accelerating rapidly, or overheating.

1. Large carbon deposits in combustion chamber.
2. Ignition timed too early.
3. Faulty distributor advance governor (weak springs).
4. Inoperative spark advance (vacuum).
5. Spark plugs.
   A. Incorrect type of plug (using a plug which is too hot).
   B. Porcelains or electrodes carbonized or burned.
6. Sharp metallic edges in combustion chamber.
7. Cylinder head gasket projecting into combustion chamber.
8. Hot engine valves resulting from:
   A. Incorrect width of valve seats.
   B. Insufficient valve clearance.
   C. Use of wrong type of valve.
   D. Thin-edged valves.
9. Lean fuel mixtures.
10. Excessive engine temperatures.
11. Poor grade of fuel.
12. Old or stale fuel.
13. Inoperative manifold heater valve (valve held in closed position).
14. Inoperative emission controls.

ENGINE BACKFIRING THROUGH CARBURETOR

1. Improper ignition timing.
2. Improperly seating valves, especially intake.
3. Incorrect valve timing.
4. Worn lobes on cam shaft.

5. Preignition from any source.
6. Excessively lean carburetor mixture.
7. Intake manifold air leaks.
8. Defective cylinder head gasket (especially between cylinders).
9. Poor quality of fuel.
10. Secondary wires improperly installed (crossed) in distributor cap.
11. Distributor centrifugal weights sticking.
12. Engine cold and choke too lean.
13. No accelerator pump action.

ENGINE CONTINUES TO RUN AFTER IGNITION IS TURNED OFF (DIESELING)

1. Idle speed set too high.
2. Improper engine timing.
3. Too lean a fuel mixture.
4. Too high a heat range on spark plugs.
5. Defective idle stop solenoid (Controlled Combustion System).
6. Inoperative emissions controls.
7. Excessive engine temperature.

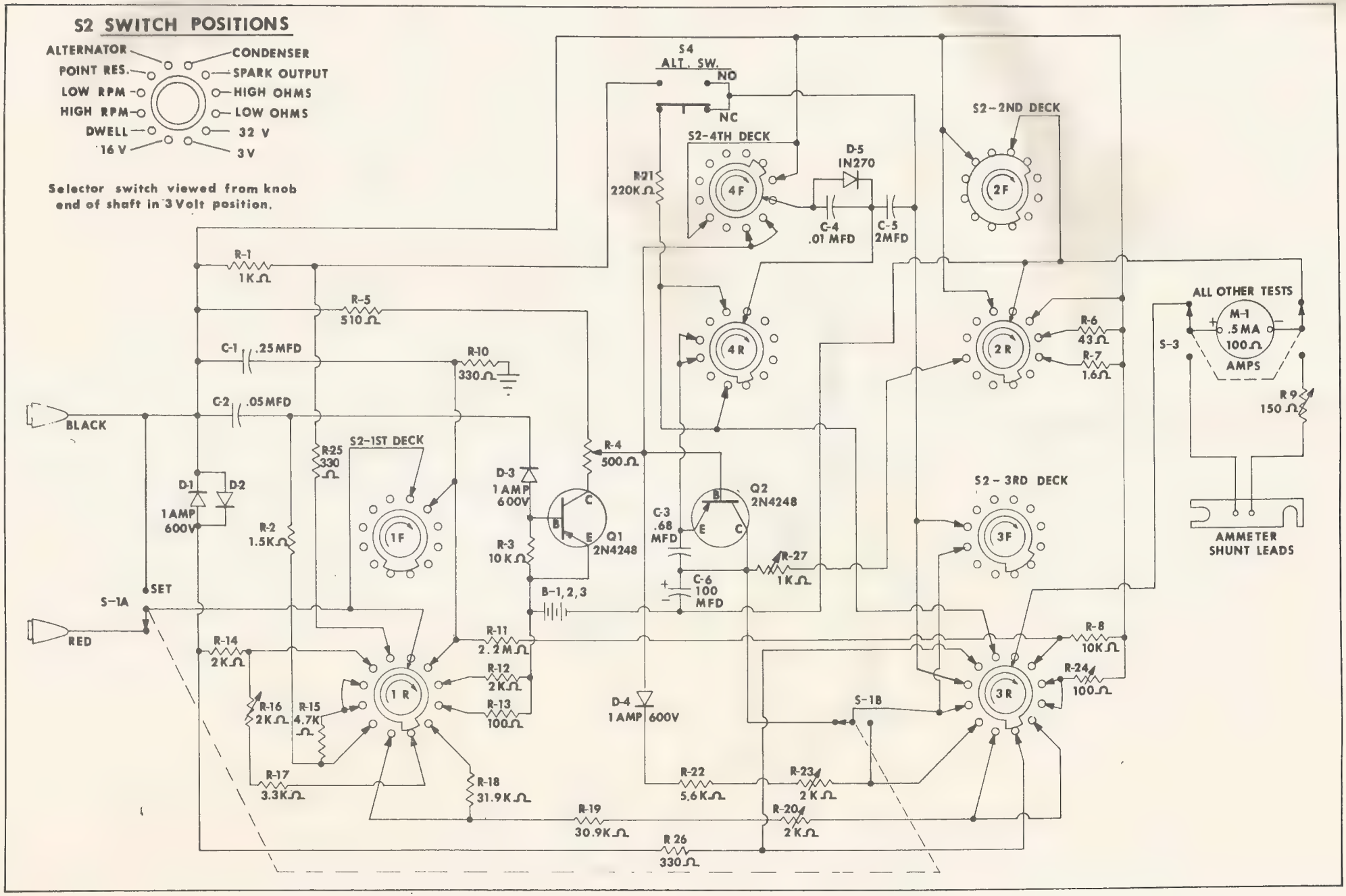
COOLING SYSTEM DIAGNOSIS
EXCESSIVE ENGINE TEMPERATURES

1. Ignition timing too late or too early.
2. Engine fan belt slipping.
3. Defective radiator cap.
4. Abnormal water loss from cooling system.
5. Radiator tubes restricted or clogged.
6. Radiator core surface restricted by grille, covers, emblems, heavy paint, insects, or accumulation.
7. Engine thermostat not opening properly.
8. Engine thermostat reversed when installed.
9. Deteriorated or collapsed water hose.
10. Water pump impeller loose on shaft.
11. Abnormal clearance of impeller in water pump housing.
12. Defective water pump or pump seal.
13. Abnormal sludge or dirt accumulation in radiator or water jacket of engine block.
14. Any condition that will result in preignition.
15. Spark advance stuck and not advancing timing.
16. Spark advance stuck in advanced position, not retarding at proper RPM.
17. Restriction of water transfer holes in engine block or cylinder head.
18. Incorrect cylinder head gasket or improperly installed gasket.
19. Engine fan blades bent.
20. Foreign matter in cylinder head, which obstructs water circulation.
21. Clogged exhaust system.
22. Defective thermostatic spark advance control valve.
23. A malfunctioning emission system.
24. High frictional resistance in engine assembly resulting from:
    A. Insufficient internal clearance.
    B. Internal misalignment.
    C. Insufficient oil circulation.
25. Dragging brakes.
26. Seized wheel bearings.
27. Abnormal frictional resistance in power transmitting units.
28. Overload on engine—towing trailer.
29. Use of certain types of anti-freeze solutions in warm weather.
30. Clutch slipping.
31. Wrong type of radiator cap.
32. Defective fan drive clutch (variable speed fans).

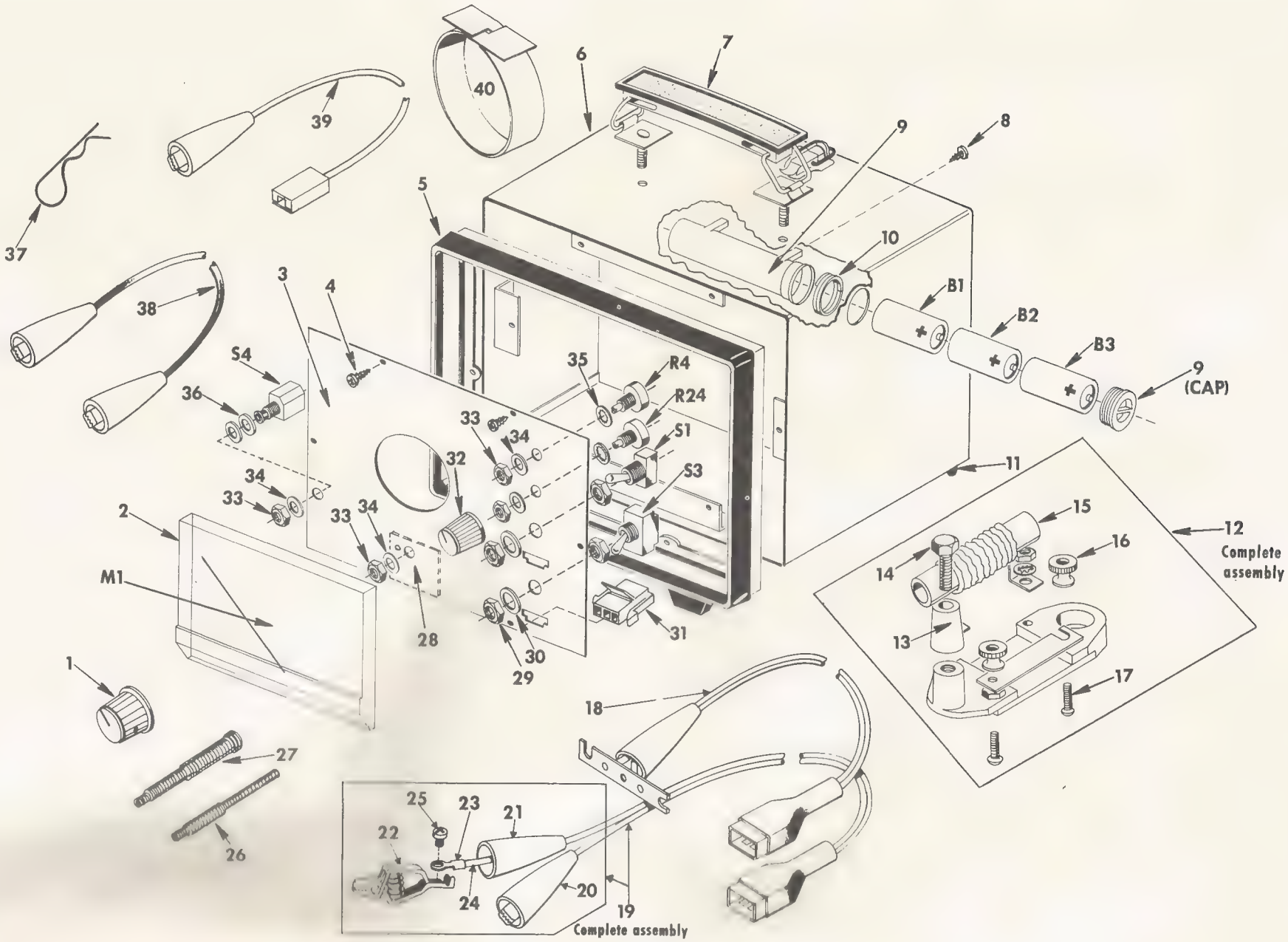
WATER LOSS FROM COOLING SYSTEM

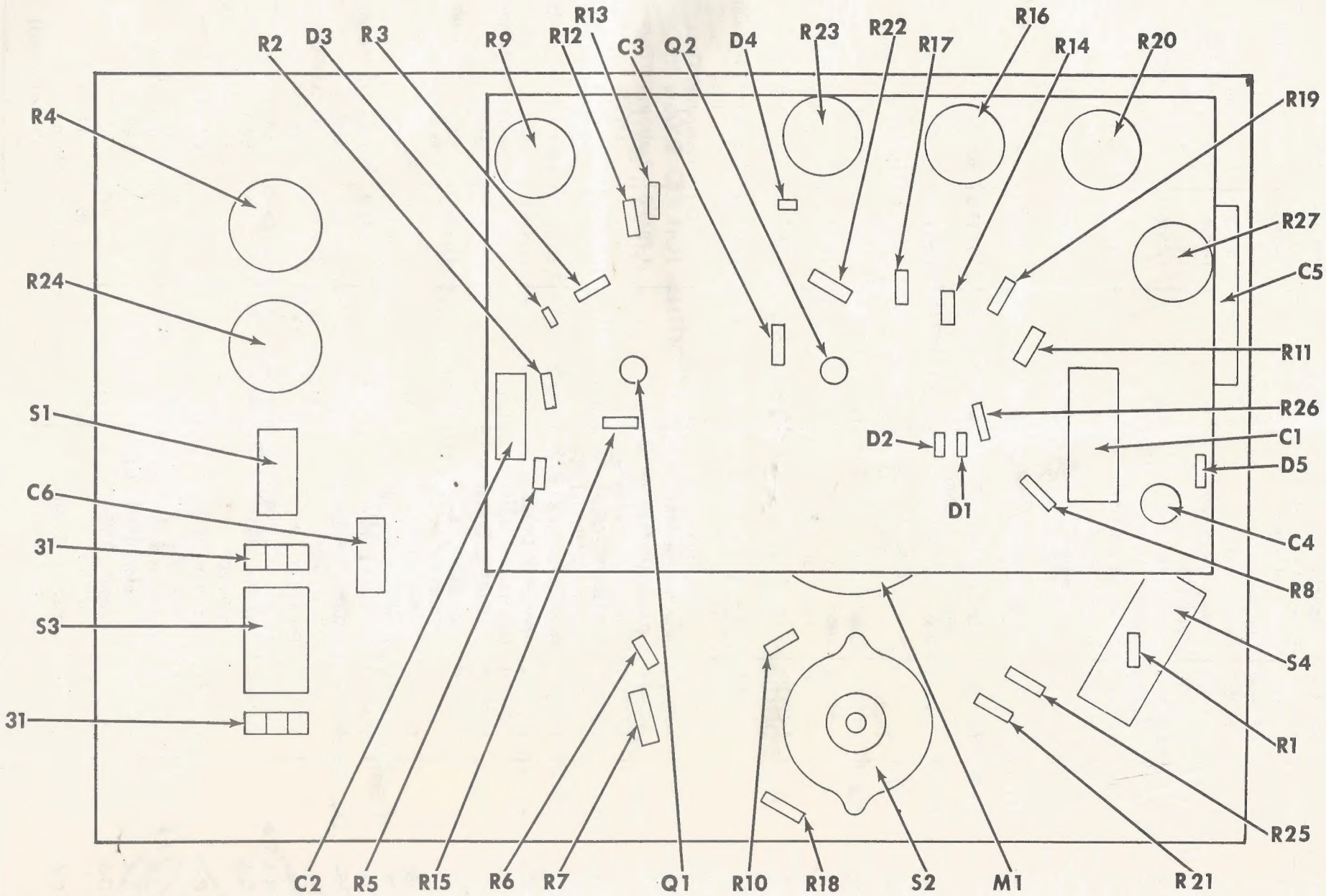
1. Defective radiator cap.
2. Radiator leaks.
3. Radiator or water pump hose leakage.
4. Cooling system drain plug or petcock leakage.
5. Water pump leakage.
6. Cooling system gasket leakage.
7. Cylinder block or cylinder head cracked (leaking externally or internally).
8. Combustion gases leaking into cooling system because of poor seal at cylinder head gasket.
9. Engine overheating resulting in water boiling and loss through overflow pipe.
10. Loose cylinder head bolts.

AUTOMOTIVE ANALYZER MODEL NO. 244.21033



AUTOMOTIVE ANALYZER MODEL NO. 244.21033




R2
D3
R3
R9
R12
R13
C3
Q2
D4
R23
R22
R17
R16
R14
R20
R19
R4
R27
C5
R24
R11
R26
S1
D2
C1
D5
C6
D1
31
C4
R8
S3
S4
31
R1
R25
C2
R5
R15
R6
R7
Q1
R10
R18
S2
M1
R21

Key No.	Part No.	Description
1.	1-7415-0	Knob, Set Screw
2.	1-5729-0	Cover, Meter
3.	1-5728-0	Panel, Front
4.	1-7476-0	Screw, #6 x 3/8" (6)
5.	1-5727-0	Bezel, Plastic
6.	1-5726-0	Case, Metal
7.	1-6101-0	Handle
8.	1-7343-0	Screw, #4 x 3/8" (2)
9.	1-6055-0	Holder, Battery
10.	1-7425-0	Coil, Spring
11.	1-7280-0	Bumpers, Snap-On (2)
12.	BP-2	Adapter, Battery Post
13.	1-7200-0	Post
14.	1-6842-0	Bolt 3/8"-16 x 1
15.	1-7043-1	Resistor, 1/4" Ohm
16.	1-7349-0	Nut, Knurled, 10-32 (2)
17.	1-6839-0	Screw, 10-32 x 1" (4)
18.	4-5012-0	Lead, Shunt
19.	4-5018-0	Lead, Test
20.	1-7102-0	Insulator, Red
21.	1-7111-0	Insulator, Black
22.	1-7129-0	Clip (2)
23.	1-7134-0	Terminal (2)
24.	1-7169-0	Lead, 6 foot
25.	1-7303-0	Screw, 6-32 x 3/16 (2)
26.	1-2239-0	Adapter, Foreign Car (4)
27.	1-2240-0	Adapter, Domestic Car (8)
28.	1-5731-0	Plate, Switch Locating
29.	1-7365-0	Nut, Hex, 15/32"-32 (4)
30.	1-7289-0	Washer, 15/32" ID Flat (2)
31.	1-7151-0	Receptacle, Amp-Lok (2)
32.	1-7474-0	Knob, Push On (2)
33.	1-7367-0	Nut, Hex, 3/8"-32 (5)
34.	1-7290-0	Washer, 3/8" ID Flat (4)
35.	1-7266-0	Lockwasher, 3/8" Int. Tooth (2)
36.	1-6222-0	Washer, Phenolic (2)
37.	1-7567-0	Adapter, Ford Coil (2)
38.	4-5027-0	Jumper Assembly
39.	4-5007-0	Jumper Assembly, Alternator
40.	1-5618-0	Fishpaper
B-1, 2, 3	1-7235-0	Battery, "C" Size (3)
C-1	1-7055-1	Capacitor, .25 MFD 600V 20%
C-2	1-7082-0	Capacitor, .05 MFD 400V 10%
C-3	1-6897-0	Capacitor, .68 MFD 20V
C-4	1-7056-0	Capacitor, .01 MFD 600V
C-5	1-7054-0	Capacitor, 2 MFD 100V 5%
C-6	1-7088-0	Capacitor, 100 MFD 6V Electrolytic
D-1, 2, 3, 4	1-7219-1	Diode, Silicon 600V
D -5	1-7215-0	Diode
Q-1, 2	1-6822-0	Transistor, 2N4248
M-1	1-5725-0	Meter, Automotive Analyzer
R-1	1-7076-0	Resistor, 1K Ohm 1/2 W 10%
R-2	1-7079-0	Resistor, 1.5K Ohm 1/2 W 5%
R-3, 8	1-7066-0	Resistor, 10K Ohm 1/2 W 10%
R-4	1-7028-1	Potentiometer, 500 Ohm 5W 10%
R-5	1-7048-0	Resistor, 510 Ohm 1/2 W 5%
R-6	1-7073-0	Resistor, 43 Ohm 1/2 W 5%
R-7	1-7050-1	Resistor, 1.6 Ohm 1W 5%
R-9	1-7015-1	Potentiometer, 150 Ohm 2W —
R-10, 25, 26	1-7024-0	Resistor, 330 Ohm 1/2 W 10%
R-11	1-7020-0	Resistor, 2.2 Meg Ohm 1/2 W 10%
R-12, 14	1-7070-0	Resistor, 2K Ohm 1/2 W 5%
R-13	1-7045-0	Resistor, 100 Ohm 1/2 W 5%
R-15	1-7036-0	Resistor, 4.7K Ohm 1/2 W 10%
R-16, 20, 23	1-7007-1	Potentiometer, 2K Ohm 2W —
R-17	1-7097-0	Resistor, 3.3 K Ohm 1/2 W 5%
R-18	1-7041-0	Resistor, 31.9K Ohm 1/2 W 1%
R-19	1-7077-0	Resistor, 30.9K Ohm 1/2 W 1%
R-21	1-7081-0	Resistor, 220K Ohm 1/2 W 10%
R-22	1-6828-0	Resistor 5.6K Ohm 1/2 W 5%
R-24	1-7001-1	Potentiometer 100 Ohm 5W 10%
R-27	1-7006-1	Potentiometer 1K Ohm 2W —
S-1	1-7201-0	Switch, Set
S-2	1-5730-0	Switch, 12 Position Selector
S-3	1-7212-0	Switch, Test
S-4	1-7208-0	Switch, Alternator Test
	3-0310-6	Manual, Owners (Not Illustrated)

GUARANTEE

We guarantee this Sears Automotive Test Instrument to be free from defects in material and workmanship. Should a defect occur within one (1) year from date of sale, simply return the instrument to us and we will repair it, free of charge.

This guarantee does not cover damage resulting from misuse, abuse or accident.

We do not authorize any person or representative to make any other guarantee or to assume for us any liability in connection with the sale of Sears Automotive Test Instruments other than those contained herein. Any agreement outside of or contradictory to the foregoing shall be void and of no effect.

This guarantee applies only to Sears Automotive Test Instruments purchased and used in the United States.

SEARS, ROEBUCK AND CO.

Sears

owners manual

AUTOMOTIVE ANALYZER

MODEL NO.
244.21033

HOW TO ORDER REPAIR PARTS

SEARS SERVICE IS AT YOUR SERVICE WHEREVER YOU LIVE OR MOVE IN THE U.S.A.

The Model Number will be found on the identification label inside the case. Always mention the Model Number when requesting service or repair parts for your AUTOMOTIVE ANALYZER.

HOW TO ORDER REPAIR PARTS

All parts listed herein may be ordered through SEARS, ROEBUCK AND CO.
When ordering parts by mail, selling prices will be furnished on request or parts will be shipped at prevailing prices and you will be billed accordingly.

WHEN ORDERING REPAIR PARTS, ALWAYS GIVE THE FOLLOWING INFORMATION AS SHOWN IN THIS LIST.

1. The PART NUMBER
2. The MODEL NUMBER 244.21033
3. The PART DESCRIPTION
4. The NAME of ITEM AUTOMOTIVE ANALYZER

Your Sears merchandise takes on added value when you discover that Sears has over 2,000 Service Units throughout the country. Each is staffed by Sears trained professional technicians using Sears approved parts and methods.

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